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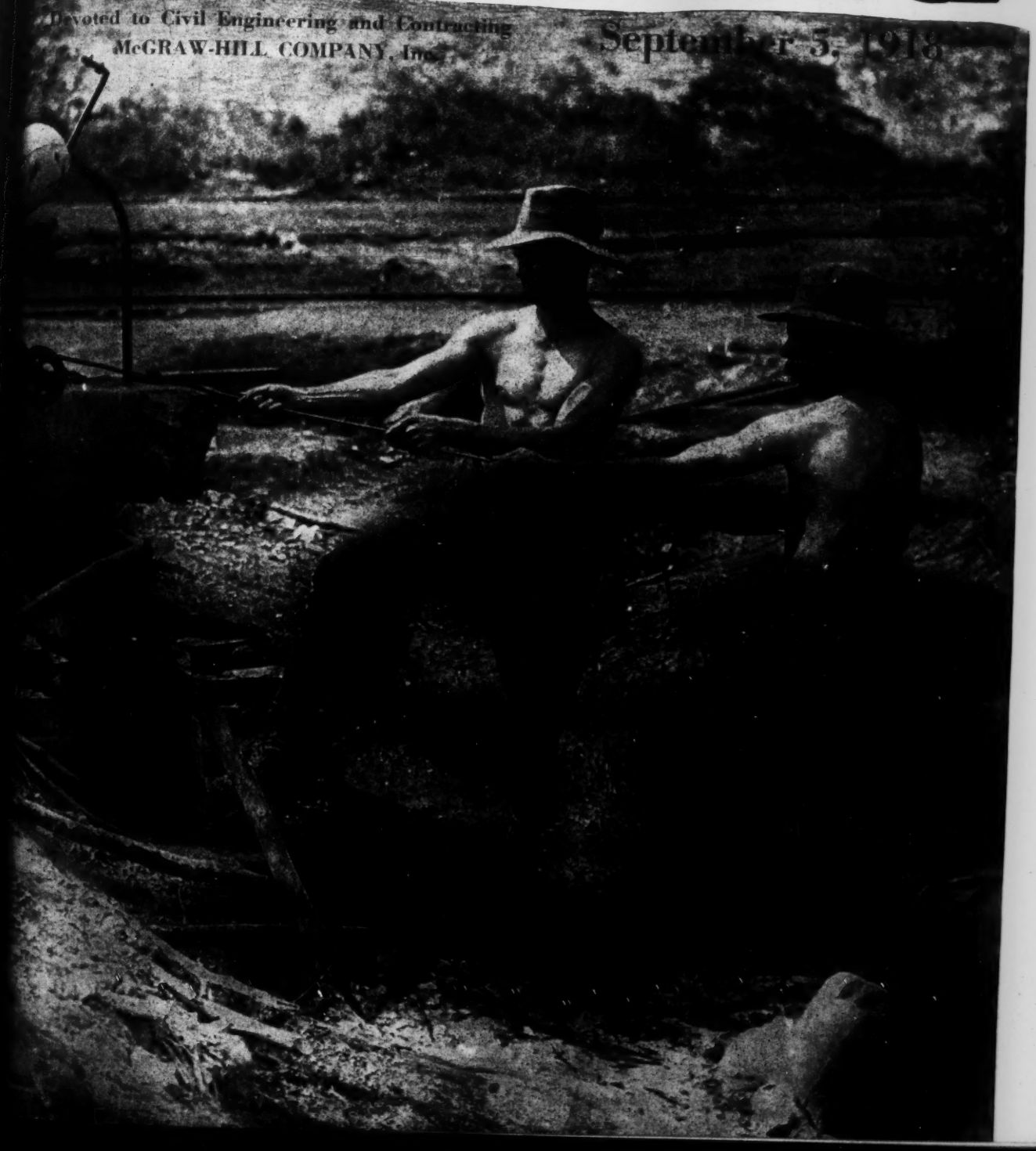
In This Issue: Another Article by R. K. Tomlin, Jr., on the Water Supply of Our Expeditionary Forces

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, Inc.
September 5, 1918



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Volume 81 September 5, 1918 Number 10

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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Published Weekly. Entered as second-class matter Apr 11, 1917, at the Post Office at New York, under the act of Mar. 3, 1879.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, SEPTEMBER 5, 1918 — Number 10

Unified Air Service Promises Better Results

INDIGNATION is a mild word to characterize the feelings aroused the country over by the senate committee report on airplane production—or lack of it. Until the Hughes report appears it may be well to say no more than that the whole airplane procedure until within recent months showed absence of efficient engineering direction, both within and without the army, combined with overweening confidence on the part of inexperienced engineers and promoters. Happily there has been much improvement since John D. Ryan became head of the Bureau of Aircraft Production and still more may be expected now that the entire airplane program has been unified under Mr. Ryan as Director of Air Service and Second Assistant Secretary of War.

More Electric Driven Pumps Would Conserve Men and Fuel

HOW to keep enough competent men to operate water-works plants is a constant and increasingly serious problem in many cities. Substitution of electric for steam power is helping out materially in some places. There are many small plants and a goodly number of large ones where electricity from central stations could be substituted for steam with a saving alike of man-power and fuel. The change should not be made by city councils or water boards without first securing competent engineering advice.

Speed Construction Methods Will Persist

SPEED construction has been the engineering wonder of the war. What has had to be done has been done. Of the great essentials to victory time has been the most effectively used. With all this speed, however, there has gone the old assumption that it is tremendously expensive and means a lavish use of men and equipment beyond the economic possibilities of peace times. One of the real engineering lessons of the war would be lost if this view prevailed. On some kinds of work, of a sort that could readily be divided into units each with multitudes of men, costs undoubtedly became abnormal, but in numerous operations permanent in nature, though driven by military necessity, the time saving was the result of careful planning, of concentrated execution and an esprit de corps which multiplied the effect of effort. Contractors and engineers will not be slow to capitalize this experience when peace returns. A premium on speed will still be asked, for there is a human limit to everything, but time standards will be revised and many new enterprises will credit to themselves thousands of dollars in earlier profits and saved capital charges as a practical result of methods developed in the war-drive construction of 1917 and 1918.

Are You Ready to Join the Fourth Liberty Loan Drive?

VICTORY for our righteous cause is nearer every day, but it is still a long road to Berlin. More men, more munitions, more supplies, all in vast numbers, must be sent overseas. More ships must be built to carry them. More money must be loaned our allies. More aid must be given to Belgium, to Russia, to all who have felt the heel of tyranny and are starving and bleeding for freedom. More billions must be provided to meet our commitments. To that end the Fourth Liberty Loan Campaign will begin Sept. 28. Are you ready? It is not enough to pledge your own subscription to the utmost. Other must be fired with zeal. Team work is required. Engineers, contractors, manufacturers, supply men, every reader of *Engineering News-Record*, are you ready to help—individually, through your firm or corporation, through your trade association, your local, state and national technical society? Read the comprehensive plan announced on advertising page 110. Then be ready to do your part. Put the Fourth Liberty Loan over the top and shorten the road to Berlin.

Saving Engineers' Time by Motor Transportation

SCARCITY of engineers for municipal service makes it more important than ever to save their time. The Chicago Board of Local Improvements has reduced somewhat the time spent by its field engineers in getting to their work by planning meeting places and daily routes. It appears that there is still much loss of time due to reliance upon infrequently run street-car and suburban railway trains to reach outlying districts and then having to walk considerable distances to get to the work of the day. In the north division of the city there was an average time loss of 20 minutes in walking to and from work alone. Record of the actual time spent by the field parties in work and in getting to and from work is being kept by the engineers this year. Besides loss of time due to lack of transportation facilities it often happens that an engineer is needed on two jobs at about the same moment. One of the jobs is either held up or else the work is carried on at the risk of errors, inefficiency and increased cost. Motor transportation has been suggested as a remedy. It is used elsewhere, though not as much as it well might be.

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With the present shortage of municipal engineers and the high salaries which they are either drawing or justly entitled to draw, conservation of their time and energy by the use of automobiles and all other proven facilities should be effected without delay

Value Based on Cost of Service

REPEATEDLY the courts have decreed that public utilities are entitled to a "fair return" on "fair value." The meaning of "fair value" is still as great a bone of contention as it was a decade ago. Original cost, reproduction cost, production cost, capitalized earnings—all have their advocates. And the advocates of each theory have had much from courts and commissions to support and to refute their theories. As yet, however, nobody knows what this elusive "fair value" is. Elsewhere in this issue Dean Raymond argues for a combination of investment and cost of operation—under the reasonable contention that the owner is justly entitled to interest on the former and profit on the latter. It is not clear how this could be applied to competitive enterprises like railroads, where the interdependence of rates must never be lost sight of; but for the local monopoly it seems to have much to commend it.

The Whine and Smile in Labor Management

WHAT a relief to meet a manufacturer these days whose first word is not a complaint over labor difficulties and labor shortage.

Recently we had one of those pleasant experiences. Our guide through a plant of 5000 men said little about the labor policies of the company. He trusted to the discernment of his visitors. But one would be blind, and insensitive in addition, to fail to see and feel the spirit of contentment, of interested endeavor, that pervaded the shop; or to notice the high average age of the workers and the very small proportion of foreigners.

These things do not just happen. And the story came out in talking with the factory and the general executives. First in importance, the White Company, motor car and motor truck manufacturers, for their plant at Cleveland is the one in question, has believed in the mature man, has valued highly his experience and steadiness. Secondly, the company has acted on the belief that the high-class men it seeks must be paid well and must progress. Consequently, it has voluntarily advanced wages with the cost of living, using Bradstreet's index figures as the basis. The wages per man have been almost doubled since 1914. There is no profit sharing. The full wage goes into the pay envelope each week. With this intelligent wage policy has gone the highest consideration for the welfare and comfort, and even the opinions and feelings of the men. No important move affecting them is made without getting the views of the shop committee, composed of one committeeman for every 10 men—a large committee, securing thorough representation.

The reasons for these policies are not philanthropic or sentimental, but are based on commonsense, hard-headed business judgment and belief in the doctrine of fair play.

"If we had a $25,000 machine in the shop," says E. W. Hulet, the superintendent, "we would put it in a glass-cased room, appoint an expert to run and take care of it and cover it at night. Why should we not treat a $25,000 man as well?" And at 6 per cent. any man who receives $1500 wages a year has a capitalized value of $25,000.

The executive heads resort to equally simple argument. "No one can run a business from a distance," said Walter C. White, sales manager. "The place for the manager is at the plant, not out on yachts, in Florida, or at the seashore. When you are on the job, you can quickly find out how things are running. If there are difficulties, don't run away. Face them, see the other fellow's point of view, and settle them on the basis of the square deal."

And the results?

No labor shortage—

Practically no spoiled work—

No strikes—

And, despite a doubling of wages an increased cost per dollar of output of only 3 per cent.

And yet the moss-backs, the divine-right industrial rulers, inveigh against labor, and form their associations for defense and sometimes for camouflage.

A little vision, a little sincerity, a little of the spirit of fair play and they would have less use for the associations.

And while they whine and fight, the Fords, and the Whites and the Filenes who have the vision and act on it go on smiling.

Contrasting Views of Water Meters

SHARPLY contrasting views of water meters are shown in clippings from newspapers in Chicago and Evanston. In Chicago, meters are little used, badly needed, strongly opposed, and, in the clipping, grossly misrepresented. In Evanston, meters have recently been introduced on a large scale and the clipping from that city shows that the dire allegations against them before their introduction were only expressions of popular fallacies or disingenuous arguments.

Following headlines alleging meter graft and robbery of the people, the Chicago *Eagle* of July 27 declared in nine paragraphs here made into one:

"The health and pocketbooks of the people are again menaced. The water meter promoters are at it again. This time a section of the daily press is backing the scheme. Water meters mean less water. Less water means poor health. Water meters are costly. They are unnecessary. The man who proposes water meters at this time is a traitor to the public."

Contrast the foregoing unsupported allegations from a city with few meters which has long been notorious for water waste and is now almost criminally burning fuel needed in war industries to pump vast quantities of water to run to useless waste with the following judicial words from the Evanston *News Index*, two days earlier.

"Last year when the meter system was installed in the homes of the city there were dire prophecies that there would be this summer no beautiful lawns, no flourishing gardens. Evanston was to become a place of

dry and barren waste because the people would hear the click of the meter registering nickels and dimes and dollars every time the hose was turned on the plants and the grass. But experience has shown that it was trouble seeking pure and simple to look forward to any such outcome of the establishment of a system by which the water user paid for what he used and for nothing else. It has apportioned the expense of running the plant in a fairer way. It has, most important feature of the new plan, effected the repairing of leaks which, before the water lost had to be paid for, were unattended, and has thus reduced the total used by the city, saved fuel and labor, and had no bad effect whatever upon the appearance of lawns and the flourishing state of the garden."

Comment is superfluous, but it may well be urged that Chicago engineers and engineering societies get behind and keep behind the water meter ordinance for which much valiant work was done a few weeks ago. The ordinance was "filed." It should be taken from the file and passed immediately, so a water and fuel saving campaign may be started without delay.

Another Threat to Stop Construction

REGULATIONS such as that of the local labor board of the District of Columbia, reported on p. 429 of this journal last week, even if inspired by the Department of Labor, should be carefully considered before being applied all over the country, according to the local lights of hundreds of local labor boards. The District board announced, among other things, that all construction work, except that for direct war purposes, must do without common labor, and that all truck drivers and teamsters not engaged in hauling material owned by or destined for the Federal Government must seek a more useful occupation. The manifest gap between the wording of the second part of this ukase and the curtailment in trucking which it is possible to effect without starving the public suggests that it may not be the intention to apply the first-mentioned section of the regulations literally to construction work. If so taken, however, this pronouncement furnishes an example of the difficulty connected with assuming control of common labor and leaving skilled labor in private hands. Withdrawing the common labor will shut down construction work completely. What is to be done with the skilled labor thus released? Have any plans been made for putting it to use? Of course, some of these skilled workers will go into the army. The majority of them, however, will not be so used under the present exemption plans of the Government. Most of them would have to throw away their skill and learn a new trade to go into a direct war industry, and a large part of them would have to move a considerable distance to reach such an industry.

Will all these things be considered? Will due consideration be given to the effect on the rapidly soaring cost of living of the great industrial waste entailed by stopping all construction? Does the Government plan to take over all residential construction in the worse congested cities which would be brought to a halt by this order? Has full consideration been given to the fact that this country owes the world other serious obligations consequent upon winning the war, and that it must be ready to meet them? Will this order of the Washington labor board be applied in the knowledge that this country is the last resort of the Allies, and that should it be compelled industrially to go the way of France and Great Britain there will be grave danger even yet that we shall lose all we are fighting for?

The country, those interested in building construction and especially contractors have a right to be fully informed on these points before local boards throughout the land begin applying these suggestions. According to varying local interpretations the contractors especially should at this moment be organized to advise with the Government on the stoppage of construction work and to furnish information from which correct conclusions can be drawn and wise action taken. The national organization of contractors which is being formed should be pushed along by every firm in the country. It is now even more necessary than before that the machinery of such an organization be got into action at the earliest date possible.

How Will the New Selective Draft Ages Affect Industry?

UNDER the new draft law passed by Congress and signed by President Wilson last week all men between the ages of 18 and 45 not now in military service are subject to call. The selective principle is retained, but the law itself says nothing about classes to be exempted.

The prospective passage of the law has stirred industry as has nothing since the war began. How will the selective principle be applied? Evidently the line will be drawn tighter than ever between the essential and non-essential industries. In other words, the "Work or Fight" principle will apply, but in the essential industries themselves what effort will the Government make to protect itself by retaining in the industries the men who are carrying the burdens of those industries—who furnish the executive brains, the energy and the enthusiasm? A great many of these men are between 35 and 45. Needless to say, their withdrawal would be a calamity. It is hard now to keep the industries going. Nothing less than stoppage would result if the main springs, the active managers, were taken. And with the decline of these industries would go not only the destruction of our industrial war program but also the net income of these companies and the consequent ability to pay taxes and buy Liberty bonds.

Beyond question our industrial structure, under the easiest condition, must suffer a very considerable alteration. This is to be expected. But the country would be the better off if business men were informed quickly of the Government's policy. Certainty should succeed uncertainty as quickly as possible. Only so can preparations be made for taking care of our industrial enterprises. The time for adjustment is all too short in any event.

A general policy needs to be declared. If interpretation is left to the local draft boards, the results to the industries and the Government may be serious.

So far the Government has applied the selective draft principle intelligently. The confidence created in the Government and in the Secretary of War should be retained by a frank declaration from the Secretary to the business men of the country at once.

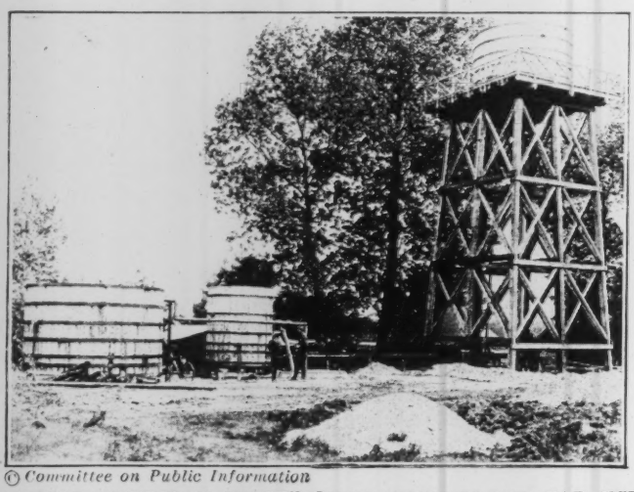
American Army's Water-Works Projects in France Number About Four Hundred

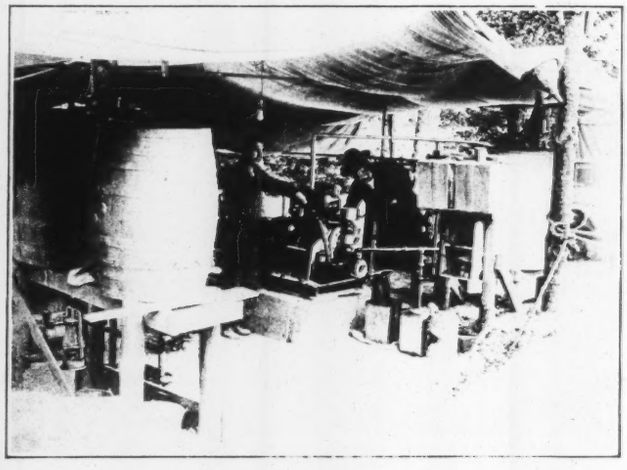
Great Range in Size and Character of Systems of Supply—Several Mechanical Filters Under Way—Laboratory Division Controls Quality of Water

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

THREE HUNDRED AND SEVENTY-FIVE separate water-works projects—ranging in scope from the utilization of a shallow farm well to the building of a curved concrete dam, pipe line and mechanical filtration plant—represented the volume of work on hand in France early in June by the water-supply division of the American Expeditionary Forces. These activities are entirely distinct from those described in the article "Water-Supply at the Front" in *Engineering News-Record* of May 9, p. 892. The figures given above indicate the extent of the program which is being carried out by our water-supply engineers, and should disillusionize those to whom "the front" and "France" have taken as a matter of course. In France, however, conditions are vastly different. Water-supply systems with house connections are decidedly the exception in all but large cities. Small towns often are supplied from wells or from springs by means of pipe lines and public taps at various points in the village streets or squares.

With the coming of the American Army into France, it became necessary at the very outset to prepare an extensive program of water-supply for hundreds of localities. For example, there are the cantonments, training areas, railroad yards and terminals, aviation fields, supply depots, ordnance plants, repair shops and hospitals—to say nothing of the big developments required





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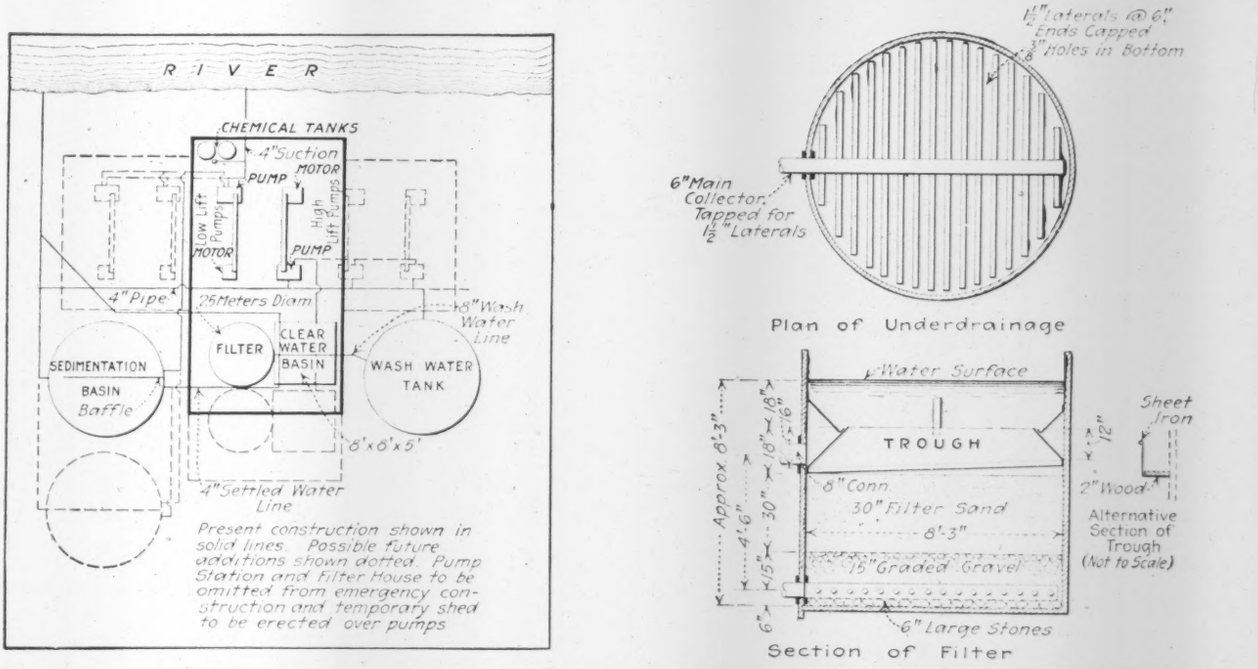
FIRST AMERICAN WATER-FILTRATION PLANT FOR USE OF THE AMERICAN EXPEDITIONARY FORCES IN FRANCE.
1. GENERAL VIEW OF TANKS. 2. PUMPING MACHINERY

become synonymous terms. As I pointed out in a former article, there is, between the coast and the so-called zone of the armies, an area containing hundreds of important centers of one sort or another, all essential parts of the military machine, where the services of the engineer are in demand. It is natural, however, that there should be a tendency for interest to focus upon the great drama which is being played in the immediate vicinity of No Man's Land and to pass by the less sensational, but highly important, activities which are being conducted in the areas of the services of supply.

Troops in large numbers are stationed in or near French villages or at sites which have been developed from farm land into large centers of population since our entry into the war. All demand water-supplies. Where existing systems are available, they are used or enlarged, but over here there is no such general provision of water-supply systems in small towns as in the United States. By the American at home the finding of running water, even in houses of small towns, is at base ports where, according to the official figures made public in July, American troops were landing on French soil at the rate of a quarter of a million per month. It is clear, therefore, that the problem of water-supply in the areas back from the front is one of segregated projects in great number rather than of a single large project.

An engineer organization reporting to the Director of Construction and Forestry, a brigadier-general, at the headquarters of the services of supply, has been formed to handle the water-supply work. At its head is a captain of engineers who was formerly principal assistant engineer in charge of the design of the $200,000,000 Catskill aqueduct for New York City. Assisting him are other engineers, experienced in the various special lines of water-works construction, filtration, sterilization, pumping machinery, etc. An important part of the work is the control of the quality of the water-supply. Laboratories for the chemical and bacterial analysis of water have been established at a number of points and are under the control of a director of labora-



FIGS. 1 AND 2. DETAILS OF FIRST MECHANICAL FILTRATION PLANT BUILT BY AMERICAN ENGINEERS IN FRANCE

tories who was formerly director of the Illinois State Water Survey.

All projects designed to obtain supplies from navigable streams or to pump water into existing French pipe lines required, originally, the approval of the French Ministry of War and also that of the local French officials. In the early stages of the work progress was delayed by the necessity of attending to a great many formalities, but recently the procedure has been simplified, and in the matter of requisitions of land, permits, etc., we are now dealing directly with French local officials, such as representatives of *Ponts et Chaussées*, prefects and mayors. This change in practice followed a request by the French Ministry of War for the submission of complete reports and plans on all water-supply projects contemplated for the use of the American Expeditionary Forces. With the limited force of men available and the huge number of projects in hand, the granting of such a request would have meant practically the shutting down of regular work for a good many weeks to prepare reports and wait for them to pass through official channels and receive the necessary approval. An understanding has been reached lately, however, whereby cumbersome procedure of this sort may be by-passed and our dealings conducted directly with the local authorities in the town or village where we are planning to operate.

As to the types of water-supply installations on which our engineers are engaged, there are, first of all, the large hospitals. At most of the 10,000-bed hospitals the water requirements are estimated to be 460,000 gal. per day. On these projects there are generally two alternatives, pumping from a river or obtaining a supply from wells. The use of liquid chlorine for water sterilization is included in many of the American Army projects.

Near the docks at one of our base sections an artesian well 700 ft. deep has been driven and is yielding about 500,000 gal. per day of excellent water, requiring no purification or sterilization.

Railroad water points must be established at frequent intervals. Negotiations are under way with the French railroads for increasing or supplementing their supplies along lines to be used by the American Army. The actual needs at these points are determined by the director general of transportation and the work is then turned over to the director of construction and forestry for whom it is handled through the water-supply division.

One of the more elaborate installations has involved the construction of a curved concrete dam 50 ft. high, and a new mechanical filtration plant. At another point an old French slow sand filter plant is being remodelled as a rapid filter.

At a port where American troops arrive in large numbers it has been necessary to supplement the existing water-supply by pumping from a river 800,000 gal. daily. The pumping station has been installed and 600 ft. of 10-in. pipe and 2200 ft. of 8-in. pipe laid. Sterilization here is by means of liquid chlorine. The French requirements as to the quality of water which we introduce into their mains are very high—no b. coli in one liter. With the liquid chlorine sterilization methods in use, we have been successful in meeting these requirements by applying a heavy dose of liquid chlorine and, later, dechlorinating with a thiosulphate solution.

The first filtration plant built in France by American engineers is situated at an aviation production center, and its general features are shown by Figs. 1 and 2. It supplies about 100,000 gal. of water per day (and may ultimately be enlarged to a capacity of 500,000 gal. daily), and it consists of an 8-ft. wooden tank containing about 30 in. of sand and from 12 to 15 in. of graded gravel. The main collector is a 6-in. pipe tapped for 2½-in. laterals. It was, of course, impossible to secure strainers, so holes were drilled at 6-in. intervals

in the under side of the lateral collectors. The annular wash-water trough is made of old biscuit tins. For cleaning the filter sand a straight water wash is employed, the velocity of the upward flow being about 2 ft. per minute.

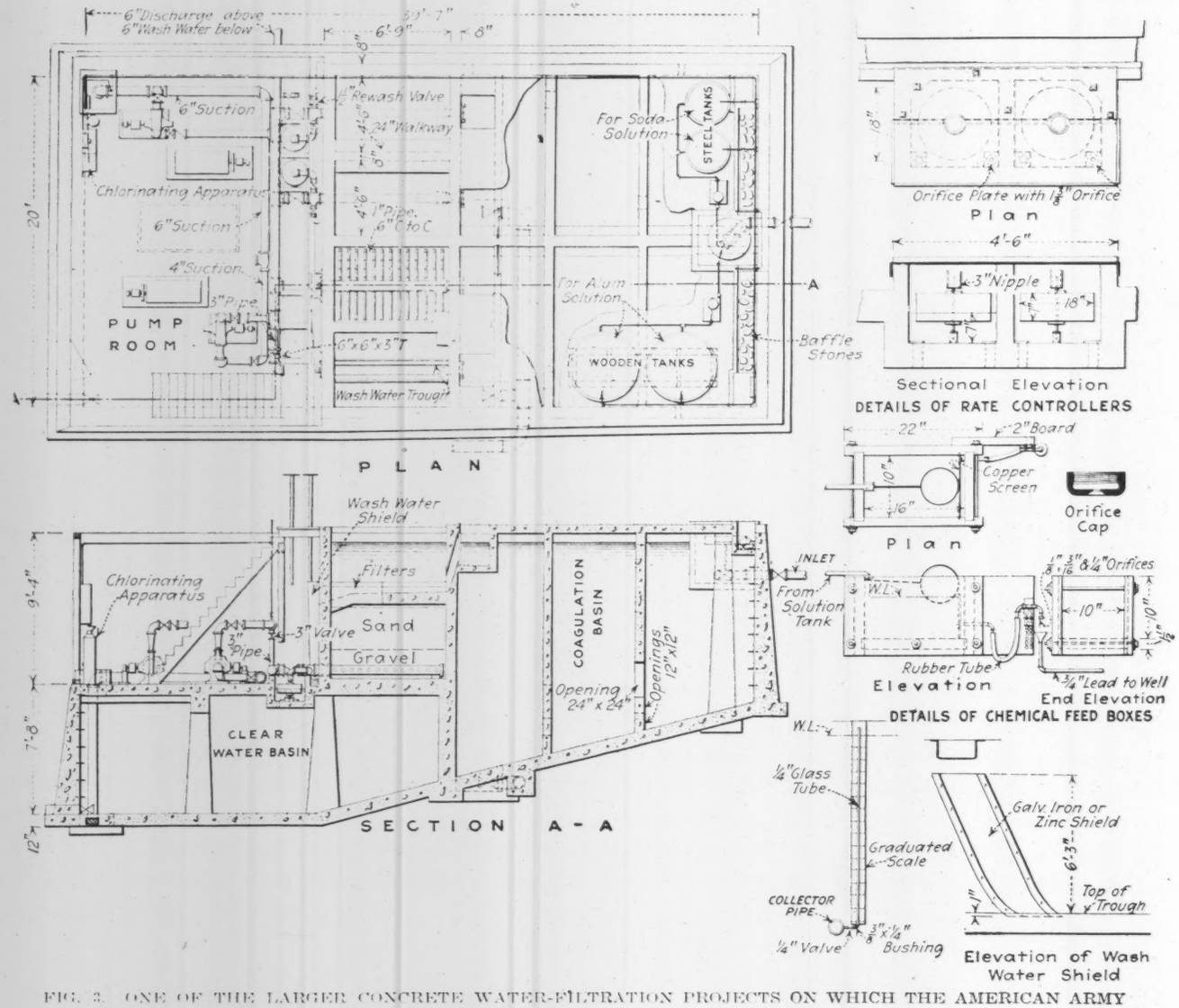


FIG. 3. ONE OF THE LARGER CONCRETE WATER-FILTRATION PROJECTS ON WHICH THE AMERICAN ARMY ENGINEERS ARE AT WORK IN FRANCE

In this plant the raw water is pumped from a river, and first passes through a circular sedimentation tank with a vertical baffle. The coagulant is an alum solution applied at the suction lift at the rate of 2 grains per gallon. The clear-water basin is concrete-lined, and wash-water is taken care of in a wooden tank whose bottom is elevated about 30 ft. above that of the filter floor. The filter effluent is treated with liquid chlorine.

One of the novel features of this plant is the pumping layout. Both the low-lift and the high-lift centrifugal pumps are driven by the same motor by means of belting and pulleys from a single shaft. The high-lift pump works against a head, including friction in the distribution system, of 160 feet.

The engineer officer who had immediate charge of this project was formerly on the staff of Morris Knowles, consulting engineer, Pittsburgh. Speaking of the design of this first filter plant and other water-works projects, he summed up the situation about in these words: "We must work with the materials at hand—not with what we might like to order in normal times, but with what we can get quickly. The procedure in design resolves itself into these steps: Get a copy of the stock list of materials at the storage yards in France, see that machinery, pipe and fittings are available and prepare a design which will fit them together."

A more elaborate filtration project is one serving a large hospital site, which is supplied from a 120,000,000-gal. reservoir formed by a curved concrete dam about 50 ft. high. From the dam a 6-in. pipe line delivers by gravity to a float chamber at the end of the coagulating basin. The water for this plant has low alkalinity and it is necessary to apply both soda ash and alum. The tank inlet is a concrete trough. The unusual feature is that this trough is filled with large stones which serve as baffles and cause a thorough mixture of the chemical solutions with the raw water before

entry into the coagulating basin. The latter is fitted with two baffle walls, as shown in the drawing, and the floor inclines toward a pump and blow off.

While the design (Fig. 3) provides for four mechanical filter units, with a combined capacity of about 330,000 gal. daily, only two of these units are being equipped at present. Each filter tank measures 4½ x 46¾ ft. and contains 30 in. of sand and 18 in. of gravel. The collector system is, in type, the same as that used at the aviation production center plant previously noted. The header is a 6-in. pipe into which 1-in. laterals, perforated with holes on the under side, are tapped. The filtered water is sterilized with liquid chlorine applied on the suction lift line of the pumps delivering to the distribution system.

The filter effluent passes through rate controllers of the type shown in one of the details of the drawings. These maintain a fixed head on pairs of 2½-in. orifices, the latter discharging into the clear-water basin.

The chemical feed control is another detail that should be noted. It is of a very simple type—a constant-head tank discharging through a flexible tube, the elevation of whose orifice end may be varied by the series of steel pin supports shown.

Another water-supply and purification project at an important base point has involved the creation of 1,500,000,000-gal. storage capacity in reservoirs 15 miles from an existing French slow sand filtration plant. This water is delivered about 10 miles of the distance by canals, and the remaining 5 miles by a 24-in. cast-iron pipe line laid on the ground surface. The old filter plant is being remodeled into a rapid mechanical filter. Before the pipe line was completed, it was necessary—so heavily was the existing plant capacity taxed—to bring water in tank boats to a point where it could be pumped into the reservoir supplying the old filter plant. The remodeled filters will have an output of 3,000,000 gal. daily.

Other Water-Supply Projects

Other places at which water-supply projects are completed, under construction or contemplated are the engine terminals and yards, the depots and repair shops, the remount stations where large numbers of horses are stabled, the aviation and the motor-truck assembly and repair centers. From these places demands for a supply of water come, and it is the duty of the water-supply division to investigate the needs and design the works. Construction is generally carried out under the direction of the commanding officer at the place where the works are to be installed. In a general way, the water-supply division performs a triple rôle—state department of health, consulting engineer and purchasing agent.

Not the smallest of its tasks is the obtaining and distributing of water-works supplies. From scores of places come calls for pipe, fittings, pumps, motors. Before the work of allocating these materials was controlled, it sometimes happened that one locality would attempt to "corner" the available supply of cast-iron pipe by direct requisition on the storage depots, leaving other water-works projects at a standstill for lack of supplies. Someone would hear that "they have just received some pumps down at ——" and the result was a rush to get there first and bring them back home. This method of scrambling for water-works supplies has been eliminated by compelling all requisitions to pass through the headquarters office of the water-supply division. One engineer spends all his time examining these requisitions and assigning the available stock where it is most urgently needed. Of course, there is generally not enough to go round. Then, too, requisitions often call for an excessive amount of material, the canny man at the other end of the line having evidently decided to put by something for the future. The result is that the engineer who allocates the material, snipping off items here, canceling whole requisitions there, is probably the most cussed-out individual in France today.

It is necessary for the water-supply division to look far ahead as to its needs. At the present writing its forecasts are completed up to April, 1919, and a regular schedule of priority for transatlantic shipment of material has been prepared. The method of requisitions for material to be placed in stock on wharves in America, with monthly tonnage priority cables, appears to be the only practical way to handle the matter, according to the chief of the division.

Quitman Garbage Incinerator Ruling

The ruling of the State Supreme Court of Georgia in the suit which resulted in an injunction against the location of a garbage incinerator in the center of Quitman, Ga., as noted in *Engineering News-Record* of Aug. 8, p. 292, has been supplied to this journal by Bennet & Harrell, of Quitman, who represented the city in the case. The decision (or syllabus?), which is comprised in a single sentence, is as follows: "Where a municipal corporation was proceeding, under contract with a crematory company, to erect an incinerator, or crematory, for the consumption of the garbage of the city, on a lot selected by it about 300 yd. from the business center of the city, upon a guaranty by the crematory company that the plant, when completed, would consume the garbage without offensive odors, etc., and where the construction of the garbage plant had proceeded to within two days of completion, and an equitable petition was filed by certain citizens, with families, living within 100 yd. of the crematory, to enjoin the further progress of the work, because of the offensive odors, gathering flies, etc., which it was alleged would be caused from the hauling and dumping of the garbage, thus endangering the life and health of the citizens and depreciating the value of their property, and where on the trial before a jury there was evidence from which the jury could find that within the city there were other available vacant lots in a different and more remote section, away from the heart of the city and residential section thereof, and that hauling of the garbage by the residences of the petitioners would cause flies and noxious fumes and poisonous gases emanating from the garbage to pester petitioners and endanger their health and lives and depreciate the value of their property, a verdict against the defendant, enjoining the completion of the crematory, was authorized."

Tractors Rough-Level Lands Before Sale to Settlers

Reclamation Engineers Get Costs of Putting Acreage on as Favorable Condition as Units First Entered Upon

LAND-LEVELING operations were initiated in 1917 by the United States Reclamation Service as one of the food-production measures advocated by the Department of the Interior. As an experiment two tractors were operated on the Truckee-Carson project to determine costs of land preparation. Since then three more have been ordered and the work of leveling will progress on a larger scale. The following notes are taken from

LAND IS PLOWED FIRST UNLESS IT IS SANDY

a paper by P. N. Cronholm in the March *Reclamation Record*, the photographs having been taken by a representative of *Engineering News-Record* who visited the project.

The plan is only to rough level the lands so that the problems of today will be no more difficult than those encountered by the first settlers on the better lands. This requires study of farm layout and proper water distribution, and will result in the elimination of non-productive areas and more production per acre.

Before the leveling is started the topography of the tract is taken. This is mainly to determine the direction of slope to be given to the lands to be rough leveled. It is used also in locating main ditches and drains that apply to the tract, as a whole, and to locate farm laterals and tail water drains.

On tracts where the general slope is hard to determine with the eye, contours every half foot in elevation should be taken; when the slope is quite pronounced intervals of 1 ft. are ample, and where the tract as a whole has a pronounced slope every 2 ft. is sufficient.

After the topographic sheet has been prepared each farm unit is studied in the field and the plan of rough leveling outlined. As far as practicable the direction of irrigation is made to agree with the slope of the land; in fact, the slope of areas as small as five acres is considered in the scheme of irrigation and division of farm units.

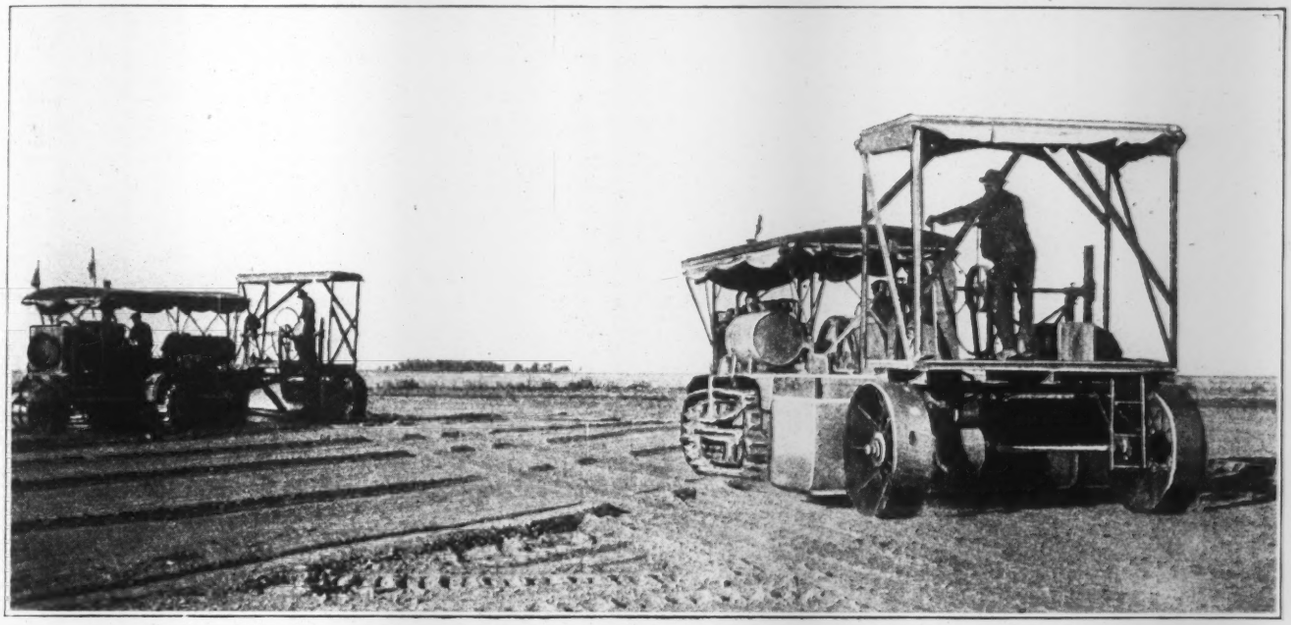
The "border-check" method of irrigation is rapidly growing in favor and is used almost exclusively on the Truckee-Carson project where lands are at all properly prepared or cropped. For this reason advantage is not taken of small level areas on farm units and to make compartments or basins of them it is usual to make grade and divide the lands so leveled into strips by building low, wide, parallel levees with the slope, 60 to 70 ft. apart. The slope of lands between levees, where soils are light, should not be less than 0.2 ft. per 100-ft. length; on more dense soils about 0.1 ft. per 100-ft. length is allowed as a minimum. The length of strips as they are being laid out by the Reclamation Service is from 330 to 660 ft., depending on topography and economic farm lateral layout and surplus irrigation water removal.

Where the general slope is steep, up to 3 ft. per 100-ft. length, depending somewhat on soils, it is possible, after a crop has been started, to use the "border-check" system of irrigation. However, to get a stand and avoid washing out the seed it is advisable, following seeding, to corrugate or furrow the lands between levees and use this method of irrigation until a fair growth has been attained. Where soils are very porous and percolation is so great that water will not find its way through the length of furrow, the length of run can be cut in two by providing a temporary supply ditch. After the crop has come through, this ditch can be dispensed with, water supplied from the ditch at the head of the lands, and the furrows and strip flooded as is the general practice with the "border-check" method.

When the lands between levees are being finished by the farmer he should keep in mind the importance of making the first 30 ft. of strip level in all directions; this permits uniform water distribution over the entire width before the water starts down the slope.

In laying out a farm unit to be rough leveled it is important to keep in mind the prevailing slope as indicated on the topography, possible water surface elevations and

WIDE SCRAPERS ARE USED IN ROUGH LEVELING



TRACTORS WORKED EVERY MINUTE OF DAYLIGHT ON LAND RECLAMATION PROJECT

the ditch and drain scheme as contemplated. After this has been roughly determined and the farm plowed to agree with the general scheme of the entire tract, a line of elevations is taken around a 5-, 10- or 20-acre portion of the unit, depending on the general slope, if any. Stakes are then set at the lower and upper ends of the land as guides for the tractors doing the rough leveling. The lands were first plowed but not disked. The sod crumbles under the weight of the equipment, and as the shaping of the land progresses the lumps disappear. In fact, sandy lands need not be plowed at all.

The lands are generally laid out in squares or oblongs, and with the view of requiring the least ditch length on each farm. The final leveling and shaping of the lands is to be done by the farmer at the time the levees and ditches are constructed. Work of this kind is usually done with horses attached to fresnos or tailboards.

If some satisfactory lighting scheme in the form of floodlights can be evolved it is intended to work the machines 24 hours per day. Should this prove practical, about 500 acres per month can be prepared; however, as it is more probable that only 16 hours will be worked, the acreage rough leveled per month will be about 300.

The two machines operated in 1917 worked 16 hours nearly every working day throughout the season. The amount of rough leveling done has averaged 126 acres per month, including all lost time, at an average cost per acre for operation of plant and equipment of $18.50; depreciation, equipment and plant, $5; engineering, $1.50; project, general, $3.75; total, $26.75. To this must be added $6 for plowing, which includes several plowings on some portions, and makes the total cost per acre $32.75.

In the tract where work is being done there are thirteen 80-acre units. Some leveling has been done on nearly every unit, and as the remaining acreage is noticeably rougher than that leveled it is assumed that when the tract is done the cost will average $40 per acre.

So far only unentered public lands have been worked on. The leveling of uncultivated settled lands has been considered but not decided upon; in fact, the terms at which the Government will require the return of the expenditures of rough leveling have not yet been determined.

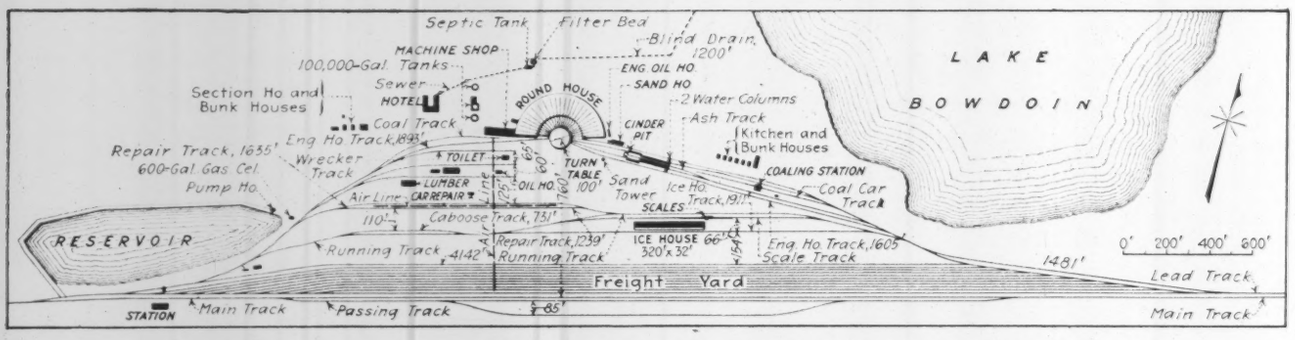
New Division Terminals Built To Meet Labor Law

Standardized Layouts at Ends of Shortened Runs Have Double-Deck Coaling Stations and Water-Treating Plants

TWO additional division points with freight terminal facilities, Wolf Point and Bowdoin, have been made necessary on the Montana district of the Great Northern Ry. in order to shorten the train runs, and thus enable the freight-train service to conform to the eight-hour law limiting the time of duty for train crews. The layouts are based on the company's standard general plan for division terminals, but have been modified and somewhat cramped at both places by reason of topographical conditions. Water-supply and coaling facilities present special features of the equipment. The layout of the terminal at Bowdoin, Mont., is shown in the accompanying plan.

The Montana district of the Great Northern Ry. extends from Williston, N. D., to Havre, Mont., a distance of 309 miles. It had originally a single intermediate division point at Glasgow, Mont., 156 miles from Williston, making two runs of a little more than 150 miles each. The distance has now been divided into three runs of a little more than 100 miles each, by the establishment of new division points at Wolf Point, 106 miles from Williston, and Bowdoin, 103 miles farther west. The new terminals were put in service Nov. 17, 1917, and the former terminal at Glasgow has been abandoned

Traffic at each of the new division points averages about 10 trains each way in 24 hours. No classification



LAYOUT OF THIS DIVISION TERMINAL AT BOWDOIN, MONT., IS A MODIFICATION OF STANDARD PLAN; GREAT NORTHERN RAILWAY

is made, but freight trains are held in the yard for the changing of engines and crews. The freight yard has 11 tracks about 4000 ft. long, and space is provided for nine additional tracks. These are connected at the west end to a ladder parallel with the main track, and at the east end to a ladder opening from a 4000-ft. switching lead which also parallels the main track. The spacing of the main and lead tracks is 20 ft. c. to c., and the body tracks are spaced on 14-ft. centers. The ladders are at an angle of 1:7 with the body tracks, and have No. 9 frogs in the turnouts for these tracks.

Beyond the yard are two car-repair tracks 1300 to 1600 ft. long, and space is provided for four more tracks, all spaced on 20-ft. centers. Two of them will be covered with a shed for a length of 800 ft. Between the repair yard and the freight yard are a caboose track and a running track, the latter being for engine movements.

Beyond the repair tracks is the yard for materials, with storehouse and lumber shed. At the east end of the yard is an icehouse with a track for supplying refrigerator cars. Adjacent to this is a scale track having a 150-ton scale with a table 50 ft. long. A compressed air line for power purposes and for testing brakes leads from the boiler house to the car repair tracks and the freight yard.

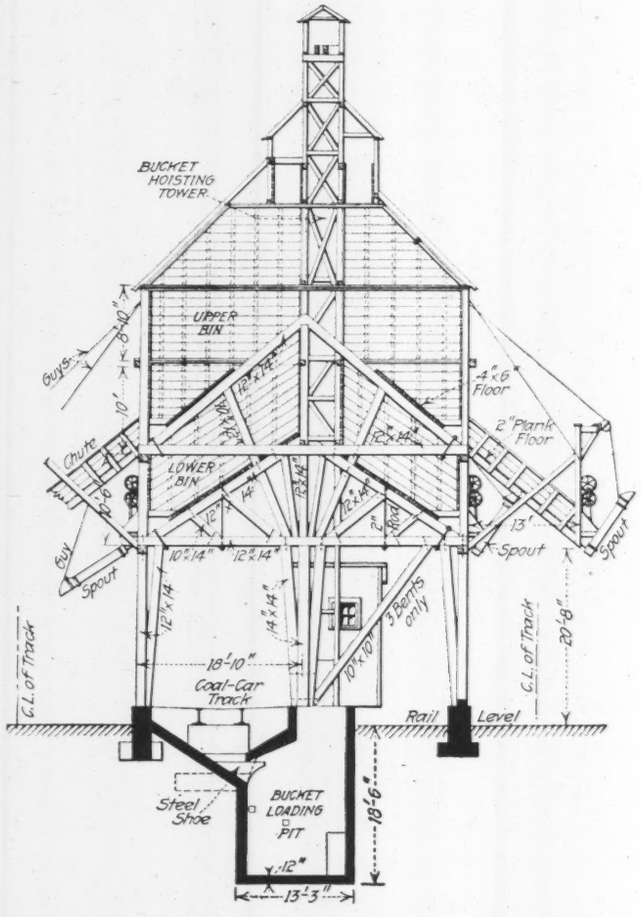
Engine terminal facilities are arranged outside of the freight yard and the repair yard. At the east end they are reached by a running track parallel with the ladder.

The 500-ton coaling station comes first. This station has a coal car track with receiving pit beneath it and engine tracks on each side. Beyond this are two tracks served by water cranes and extending over concrete cinder pits 70 ft. long, with provision for a future length of 140 ft. A depressed track for ash cars is placed between the two pits, the ashes being shoveled down inclined surfaces to the cars. The two outer tracks provide for moving engines past those standing at the coaling station and cinder pits.

These four engine tracks converge upon a 100-ft. tractor operated turntable, beyond which is a single track leading to the main line. A 25-stall roundhouse has been built, and provision is made for a 21-stall extension. This building is of brick, and has a frame roof.

The stalls are 104 ft. long, and an annular space 61 ft. wide separates the house from the turntable. Adjacent to the house are a machine shop and a boiler room. A stub track provides for coal cars to serve the boiler room, and a similar parallel track accommodates the wrecking train of the division.

The coaling stations are a special design of the Williams-White type with vertical bucket hoist. They are of frame construction. Each is capable of handling from one to four kinds of coal, as may be required, and of delivering coal to engines on four tracks, two on each side of the building. The 500-ton elevated bin is a double-deck structure divided into four compartments, which are fed by two 1½-ton buckets operating in a tower in the center of the bin. These buckets are arranged to dump in either direction, so that in combination with deflecting chutes they can discharge into any one of the compartments. The hoist is operated by a 20-hp. oil engine placed in a fireproof house, and



COALING STATION CAN HANDLE FOUR KINDS OF COAL AND SUPPLY FOUR ENGINES AT ONCE ON FOUR TRACKS

the buckets are automatically dumped and reversed for reloading. Extension spouts provide for delivering coal from the upper compartments of the bin to engines on the outer tracks, as shown in the drawing.

The water-supply at Wolf Point is taken from six drilled wells, 50 ft. deep, and is pumped to a 100,000-gal. tank on a steel tower 50 ft. high. This water is treated in a softening and sedimentation plant having a capacity of 200,000 gal. daily. Treated water is delivered to a 100,000-gal. tank 20 x 30 ft. on a timber tower 30 ft. high. From this it is piped to the standpipes or water columns for supplying the engines, and also to the shops and the repair yard.

At the other terminal, water is taken from Bowdoin Lake. As this lake is very shallow and the water becomes extremely bad toward the end of winter, a reserve supply is pumped to a reservoir of 1,000,000 gal. capacity. The company intends to take the supply eventually from an irrigation ditch diverting water from Milk River, and as this will be available only during the irrigation season, the reservoir was built to permit of its being filled by gravity flow. When further storage is needed a second reservoir can be built, or the sides of the present one may be raised to increase the capacity, the additional water being pumped either from the ditch or from wells near the roundhouse. Under the present laws, however, the U. S. Reclamation Service cannot grant the right to use the irrigation water, and the lake must be depended upon.

Water-treating plants are installed at both places and are similar to those constructed at numerous points along the 640-mile stretch between Devil's Lake, N. D., and Cut Bank, Mont. They are of the type designed by C. Herschel Koyl, engineer of water service for the Great Northern Ry. Economy in the use of water has been the subject of special attention at the two new terminals. Arrangements have been made for the use of raw water wherever it will serve the purpose, such as for washing out boilers, while warm treated water is provided for refilling the boilers.

Grading and tracklaying at Wolf Point were done by A. Guthrie & Co., St. Paul, while the buildings and the water-treating plants were constructed by W. F. Hill, Superior, Wis. At Bowdoin, the grading, track-laying and construction of buildings and water-treating plant were done by Grant Smith & Co., of St. Paul. The two coaling stations were built by the Howlett Construction Co., Moline, Ill.

Design and construction of these new terminals were under the direction of A. H. Hogeland, chief engineer of the Great Northern Ry. H. J. Seyton and G. A. Zachrison were assistant engineers in charge of work at Bowdoin and Wolf Point, respectively. Both reported to P. S. Hervin, resident engineer at Great Falls, Mont.

Cleaner and Better Streets for Detroit

Coöperation in a movement for cleaner streets is being urged by H. H. Esselstyn, the new commissioner of public works of Detroit. Street cleaners, garbage collectors, representatives of social, civic, business and political organizations, and the public generally, were recently invited to attend a conference and make suggestions regarding the cause and cure of dirty streets and pavements in bad repair.

Computing the Lateral Pressure of Saturated Earth

Proposed Method Takes Account of Separation of Hydrostatic From Earth Pressure, But Allows Full Hydrostatic Pressure

By A. G. Husted

Engineer, Department of Public Sanitation, Indianapolis, Ind.

FORMULAS giving the lateral pressure of earth against vertical walls may be found in many textbooks and handbooks. These formulas, however, usually refer to dry earth, and not to earth which is saturated with water. The writer has had occasion, when designing structures wholly or in part below water level, to calculate the lateral pressure of saturated earth, and being unable to find a satisfactory method for computing these pressures, has worked out the method herein set forth.

The usual formula giving unit lateral pressure is $p = w\ h \tan^2 (45° - \frac{1}{2}\Phi)$, where p is the unit lateral pressure, w is the weight of earth per cubic foot, h is the distance below the surface, and Φ is the angle of repose. Since the unit pressure varies directly with the depth, the total pressure per unit length of wall is equal to one-half the unit pressure at the bottom multiplied by the height. Thus $P = \frac{1}{2} w\ H^2 \tan^2 (45° - \frac{1}{2}\Phi)$, where P is the total lateral pressure and H is the total height. This is the form in which the formula is usually given. In this discussion, however, the formula giving unit pressures, $p = w\ h \tan^2 (45° - \frac{1}{2}\Phi)$, will be used, for obvious reasons.

Relation of Lateral Pressure to Vertical

As has been noted before, this formula assumes that the lateral pressure at any point bears a definite relation to the vertical pressure, this relation depending entirely upon the angle of repose. It will thus be seen that the second part of the equation can be divided into two parts, $w\ h$ representing the unit vertical pressure and $\tan^2 (45° - \frac{1}{2}\Phi)$ representing the relation between lateral and vertical pressures.

Two methods of applying this formula to cases involving saturated earth have been and are still in quite general use. One of these methods consists in computing the total lateral pressure in the usual way, using for w the weight of dry earth and for Φ the angle of repose of dry earth. To this pressure, then, is added full hydrostatic pressure below the plane of saturation. This method may quite often give results close enough to actual conditions for ordinary purposes of design, but it appears to the writer to be at variance with the fundamental formula. In the first place, no allowance is made for the fact that saturated earth has a smaller angle of repose than dry earth, and in the second place it is assumed that earth weighs the same in water as it does out of water.

Another method of calculating lateral earth pressures consists in computing the total lateral pressure in the ordinary way and adding to this partial hydrostatic pressure below the plane of saturation. The amount of the partial hydrostatic pressure to be added is determined by taking the difference between full hydrostatic pressure and lateral earth pressure for an equivalent

depth. This method, however, can easily be proved erroneous by applying it to a fill of completely saturated earth. In this case the partial hydrostatic pressure to be added will be the difference between full hydrostatic pressure and lateral earth pressure for the total depth of earth. It can thus be seen that the total lateral pressure at the bottom would be exactly equal to full hydrostatic pressure. This is absurd.

In order to correct the errors in the above mentioned methods, a method has been worked out which the writer believes to be theoretically correct. In this method the following assumptions are made:

Lateral earth pressure varies directly with the vertical earth pressure for earth with any given angle of repose and is equal to the vertical earth pressure multiplied by $\tan^2 (45° - \frac{1}{2}\Phi)$.

Water exerts full hydrostatic pressure laterally as well as vertically, regardless of the amount of space occupied by earth.

It is a well-known fact that the angle of repose of earth in water is less than the angle of repose of dry earth. Therefore, the ratio of lateral pressure to vertical pressure is greater below the plane of saturation than above. On page 580 of Merriman's "American Civil Engineers' Pocket Book" the angle of repose of dry soil is given as 36°53′, while that of soil under water is given as 15°57′.

Above the plane of saturation the lateral pressure is computed in the usual manner. Below the plane of

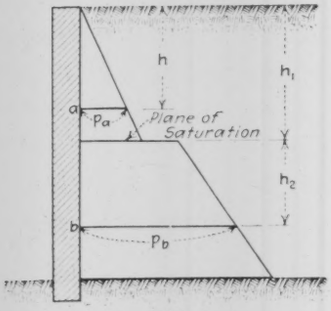


FIG. 1

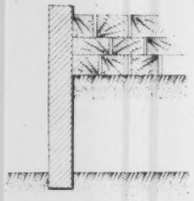


FIG. 2

saturation the lateral pressure is obtained by multiplying the total vertical pressure less the buoyant effect of water by $\tan^2 (45° - \frac{1}{2}\Phi)$ and adding to this the full hydrostatic pressure. For example, in Fig. 1 the unit lateral pressure p_a at point a which is above the plane of saturation is $w_1 h \tan (45° - \frac{1}{2}\Phi)$. W_1 is the weight of dry earth per cubic foot, h is the distance of the point a below the surface and Φ_1 is the angle of repose of dry earth. Likewise the unit lateral pressure p_b at point b below the plane of saturation is $(w_1 h_1 + w_2 h_2) \tan^2 (45° - \frac{1}{2}\Phi_2) + 62.5\, h_2$. W_1, as above, is the weight of dry earth per cubic foot, h_1 is the distance from the ground surface to the plane of saturation, w_2 is the weight per cubic foot of earth under water, h_2 is the distance of the point b below the the plane of saturation, and Φ_2 is the angle of repose of earth under water.

It will be noticed that in this method, for points below the plane of saturation, hydrostatic pressure and earth pressure are separated; that full hydrostatic pressure is allowed; that the vertical earth pressure is obtained by adding the total weight of earth above the plane of saturation to the net weight (weight under water) of earth below the plane of saturation; that the lateral earth pressure is obtained by multiplying this vertical pressure by $\tan^2 (45° - \frac{1}{2}\Phi_2)$; that the total lateral pressure is obtained by adding the hydrostatic pressure to this lateral earth pressure.

It can be readily seen that if a smaller angle of repose is assumed for saturated earth than for dry earth, there will be a decided increase in the unit lateral pressure at the plane of saturation. In other words, the unit lateral pressure an infinitesimal distance below the plane of saturation will be much greater than that at an infinitesimal distance above the plane of saturation.

At first thought this appears absurd, but it can be seen that it should be so. It can perhaps be best illustrated by an exaggerated example. Take the case of a retaining wall supporting a bank of earth loaded with timbers (Fig. 2); the lateral pressure of the timbers against the wall is zero, but at an infinitesimal distance below the surface of the earth the pressure is a considerable amount due to the load that is superimposed.

The difference is plainly due to a difference in the angle of repose.

The problem of obtaining the resultant lateral pressure is comparatively easy after the unit lateral pressures have been computed. This can be best illustrated by a practical case. Take for example a wall supporting 10 ft. of earth, the lower 6 ft. of which are below water level and hence saturated. Assume dry earth at 100 lb. per cubic foot, and earth under water at 70 lb. per cubic foot. Assume a natural slope for dry earth of 1½ to 1 ($\Phi_1 = 33° 41'$) and for the earth under the water of 2½ to 1 ($\Phi_2 = 21° 48'$).

Lateral pressure at the plane of saturation due to dry earth $= 100 \times 4 \times \tan^2 (45° - 16° 50.5') = 114.4$ lb. per square foot.

Lateral pressure at plane of saturation due to saturated earth $= 100 \times 4 \times \tan^2 (45° - 10° 54') = 183.2$ lb. per square foot.

Lateral earth pressure at the bottom $= (100 \times 4 + 70 \times 6) \tan^2 (45° - 10° 54') = 374.6$ lb. per square foot.

Hydrostatic pressure at the bottom $= 62.5 \times 6 = 375$ lb. per square foot.

Total lateral pressure at bottom $= 374.6 + 375 = 749.6$ lb. per square foot.

Total resultant lateral pressure above the plane of saturation per foot length of wall is $114.4 \times \frac{1}{2} \times 4 = 228.8$ lb. This is applied at a point 1⅓ ft. from the plane of saturation or 7⅓ ft. from the bottom of the wall.

Total resultant lateral pressure below the plane of saturation is $\frac{1}{2}$ (183.2 + 749.6) × 6 = 2798.4 lb. This is applied at a distance of $\frac{6}{3}\left(\frac{749.6 + 2 \times 183.2}{749.6 + 183.2}\right)$ or 2.4 ft. from the bottom.

The resultant lateral pressure against the wall per foot of length is then 228.8 lb. + 2798.4 = 3027.2 lb. This is applied at a distance of $\frac{228.8 \times 7.3 + 2798.4 \times 2.4}{3027.2}$ = 2.77 ft. from the bottom.

Water-Supply, Sewerage and Heating for Florida Home

Engineer Designs and Supervises Construction of Domestic Systems — Iron Removal — Imhoff-Dortmund Tank

By W. G. Kirchoffer
Sanitary and Hydraulic Engineer, Madison, Wis.

After having designed water-supply and sewerage systems for individuals, corporations, and municipalities for the past twenty years, the writer had the pleasure during the past winter of not only designing these systems for his own winter home at St. Petersburg, Fla., but of building them as well.

At this place water is found in the sand under a layer of hardpan at a depth of about 16 ft. and the usual method is to drive a 1¼-in. pipe and "point" to the proper depth. The point was 4 ft. long, of No. 60 gauze. The water obtained from this well is soft, but contains iron and tannic acid, which colors the clothes in the laundry, and on being heated for the bath produces a dark brown suspended precipitate. When fresh it is not a bad drinking water, certainly as good as most Florida waters.

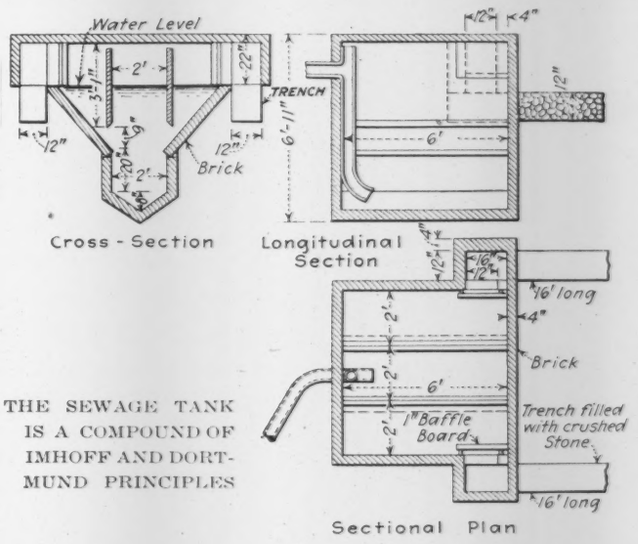
For use in the laundry the water was treated the night previous with a small quantity of lime and allowed to settle in a common tub. In the morning it was strained through three or four thicknesses of linen. The straining removed the objectionable precipitate.

For pumping equipment I was able to obtain a second-hand "tank" pump with a 2½-in. cylinder and a 4-in. stroke. This had to be operated by hand. For the storage of water two 50-gal. barrels were used, as no galvanized-iron tank, or the material to make one with, could be purchased. These barrels were located in the attic of the house with the tops approximately level with the top of the expansion tank on the heating system. This gave a pressure of about 10 lb. per square inch at the pump, which was sufficient for all purposes.

Combination Sewage Tank

The sewage from the house was carried by a 4-in. sewer to the rear of the lot, where a digestion tank was constructed. This tank was constructed so as to combine the principles of the septic, Imhoff and Dortmund tanks.

The sewage enters the central deep compartment and is carried to a point near the bottom by a vertical vitrified pipe. From this digestion chamber the liquefied sewage rises to the slots below the baffle boards and passes into the side chambers. One-half of the sewage is supposed to flow each way. The bottoms of these chambers are built on a slope of 1.2 to 1, so that any organic matter settling out will slide down the steep slopes and be returned to the central digestion chamber instead of passing out of the tank or being retained in the side chambers. The outlets are at the end opposite the inlet and they are also protected by baffle boards so as to prevent any floating solids in the side chambers from leaving the tank. This tank may be said to consist of a central digestion tank of the Dortmund type and two side settling chambers of the Imhoff type. However, the essential difference between this



THE SEWAGE TANK IS A COMPOUND OF IMHOFF AND DORTMUND PRINCIPLES

and an Imhoff tank is that the sedimentation chambers follow rather than precede the digestion tank. It is expected that by this arrangement a better digestion of the sludge will take place and the clarification of the effluent will be more complete than that which takes place in an Imhoff or septic tank, where the sewage is extremely fresh. The effluent from this tank flows into two ditches 12 in. wide by 18 in. deep, filled with crushed rock (broken concrete). This was covered with old boards and a covering of earth was put over the whole.

The tank has a capacity sufficient for 10 to 12 persons, but only three used it the past winter, with very satisfactory results.

The amount of radiation was determined by the B.t.u. method, the following assumptions being made: Outside temperatures, 40°; inside, 70°; changes of air per hour, two; B.t.u. given off by one square foot of radiation per hour, 200. For a difference of temperature of 30° multiply each cubic foot of space by 0.6 B.t.u. For 30° difference in temperature multiply square feet of glass by 36 B.t.u. For exposed wall 15 B.t.u. For each square foot of floor and ceiling nine B.t.u. per hour.

The house was of the ordinary frame construction without plaster, but the exterior walls of all the rooms except the living-room and den were ceiled as an after consideration, so that the radiating surface provided is liberal for these rooms on the basis assumed.

Hot-Water Heating System

The requirements for this plant were so small that a hot-water heater having a capacity of 335 B.t.u. per hour was specified. The sizes of pipes were chosen from standard tables for hot-water heating. This heater was provided with a coil for heating water for the bathroom, independent of the heating system, or by opening two valves the entire heating capacity of the heater could be applied to the hot-water tank.

An expansion tank was provided in the attic on the same level as the top of the water-supply barrels, so that when the hot-water tank was connected to the heating system the expansion tank would not overflow.

The overhead system of distribution was adopted so

as to eliminate air troubles, and as far as possible keep heating pipes in the room, rather than under the floor, where they would have been exposed to outside air.

Wood is used as fuel at present, as there was plenty of waste from the lumber used on the house and from trees removed to make room for it.

It is not expected that this plant will have to be used continuously, but mostly mornings and evenings during cool spells and for the bath. Under these conditions wood firing will not be objectionable.

A local plumber wanted $200 to install the heating system, not including the heater and radiators, which I considered as excessive. The mason who was putting in the sewerage system and his colored helper offered to do the work for me by the day, with the result that more than $100 was saved on the heating system. All of the work was done by these two men on all three systems, under my constant supervision. The costs were as follows:

HEATING PLANT	
Freight and drayage	$22.73
Pipe and fittings	49.20
Labor	26.00
Eight radiators, 204 sq.ft.	74.33
Heater	65.36
Total	$235.83
WATER SYSTEM	
Pump	$10.00
Hot-water tank	10.15
Well	10.55
Pipe and fittings	7.95
Total	$38.65
SEWERAGE	
Brick, lime and cement	$28.59
Mason, two days' time	10.00
Helper, two days' time	4.00
Total	$42.59
Total of three systems	$317.07

Resurface Brick Pavements with Asphaltic Concrete

Raised Crosswalks Have Been Eliminated and Narrow Strips of Surfacing Have Been Used on Wide Streets in Topeka

PROCEDURE in resurfacing old pavement laid with comparatively soft brick, at Topeka, Kan., includes the removal of raised crossings at intersections, the substitution of concrete for the brick gutters and the covering of the old surface with asphaltic concrete.

CARPET STRIP FEATHER EDGE DISINTEGRATES FAST

Narrow carpet strips have been used on some of the streets, without changing existing curbs and gutters, to overcome the roughness of the old brick surface.

Many of the busier streets, which were paved with brick 20 or 30 years ago, have shown disintegration of the brick surface, while the foundation has settled unevenly in places and over trenches cut for sewer or public utility installations. However, it is assumed that this surface and the foundation have become stable under the traffic of years, even at depressions, and consequently the wearing surface is applied without leveling the old pavement, unless it has entirely broken down.

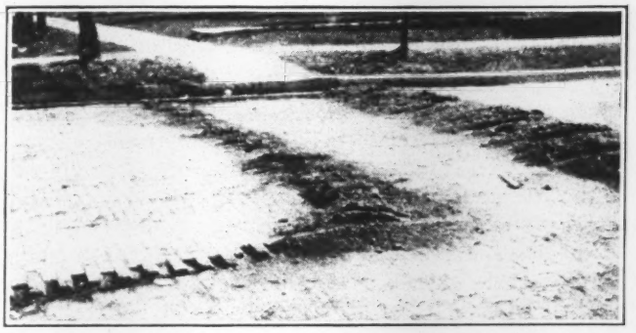
The advent of the automobile has so emphasized the inconvenience and narrowing effect of raised crosswalks that, even on the wider streets, the citizens have demanded a change in design to meet the wishes of the user of the roadway, rather than the doubtful convenience of the pedestrian. On Topeka Ave., a 130-ft. street, where eleven blocks were resurfaced in 1917, and three more are being repaired this season, all of the crosswalk humps are leveled by relaying the old brick flat monolithically, and with grout filler, thus replacing the old deep sand bed. For the gutters the brick and sand bed are replaced by concrete 2 ft. wide, which is 6 in. deep at the undisturbed sandstone curb and 8 in. deep at the outer edge. This leaves a 2-in. edge against which to butt the asphaltic concrete, but does not lessen the former depth of the gutter. Photographs of the depressed walks and concrete gutters are shown.

For a few of the wider streets, 1½-in. asphaltic concrete carpet strips have been laid for a width of 8 ft. on each side of the car tracks, and 16-ft. strips have been laid on streets having no tracks. The feather edges of these carpet coats as first laid were their vulnerable points and they have been abandoned for a 45-deg. slope banked with a hot iron and tamped by hand, the roller not being permitted to work within 6 in. of the edge. The thin edge was found to oxidize and crumble after a year's wear, and, once started, the disintegration extended rapidly toward the center.

While laying the asphaltic surface, it is the practice to take samples and make an analysis of the asphaltic

ABUTTING EDGE FOR ASPHALT FORMED BY GUTTER

mixture every day, and to retain a small portion in a tin box, properly labeled, as a sample of the mixture used. One of the vital points in getting the carpet strips to stick, is in the preparation of the old brick surface. It is essential to sweep the surface perfectly



REMOVE CROSSWALK HUMPS BY RELAYING BRICK FLAT

clean, and have it absolutely dry. It is then painted with 60% of asphaltic cement, which is cut back with 40% of domestic distillate. This makes the consistency such that it may be readily brushed over the brick surface, leaving a thin, even coat which will be perfectly dry in 24 hours or less. The 1-in. binder course and the 2-in. wearing surface, on repaving work, are applied with substantially the same precautions observed in the laying of new work on a concrete base. Depressions, however, are filled first with the binder to make the surface level.

The carpet strips are contracted for by the ton. Last year the cost of repaving, exclusive of curb work, was 90c. per square yard, but this year the price has been raised to $1.10 per square yard. The repaving work is done by contract under the immediate direction of W. E. Baldry, city engineer. It is paid for by the assessments on abutting property.

Flow in Chicago Water Tunnels Is Tested by Salt Solution Method

CAPACITY TESTS of the northwest lake and land water intake tunnel system at Chicago, described in the 1917 report of Department of Public Works, showed good results for brick-lined tunnels and a smaller coefficient of roughness than is usually found in tunnels of this size. The intake system consists of 20,700 ft. of 10-ft. tunnel from the Carter H. Harrison crib (14,033 ft. from shore) to the Green Street shaft, whence one 8-ft. tunnel extends 19,856 ft. to the Central Park Ave. pumping station and another 8-ft. tunnel extends 22,183 ft. to the Springfield Ave station. A short 7-ft. branch connects the 10-ft. tunnel with the Chicago Ave. station.

The mean velocity of flow was determined by observing the time it took for a sodium chloride solution to pass between various points, electrical indicators being used for the purpose. Water elevations were also noted. The amount of water passing through the 10-ft tunnel was larger by 41.05 cu.ft. per second than the sum of the flows in the two 8-ft. tunnels. This represents the leakage through the 7-ft. branch to the Chicago Ave. pumping station.

Considering the variations in velocities the factor C varies only from a maximum of 126 to a minimum of 120 for the 10-ft. tunnel and the coefficient n varies from

PUMP, PITOMETER AND HYDRAULIC OR SALT-SOLUTION TESTS OF CHICAGO TUNNEL CAPACITY

	Flow in cu. in. per second — Central Park Ave. Station	Springfield Ave. Station
By pumping record	167.28	140.42
By pitometer	119.22	118.77
By hydraulic tests	130.17	115.94

0.0139 to 0.0145. The values of the coefficient of roughness n give an average of 0.0141 for the Central Park Ave. tunnel and 0.0134 for the Springfield Ave. tunnel. Assuming the hydraulic test figures in the accompanying table to be the correct pumpage, the slip is equal to 22.18% for the Central Park and 17.43% for the Springfield Ave. tunnel. The tests were made by F. A. Smith, assistant engineer, under the direction of John Ericson, city engineer.

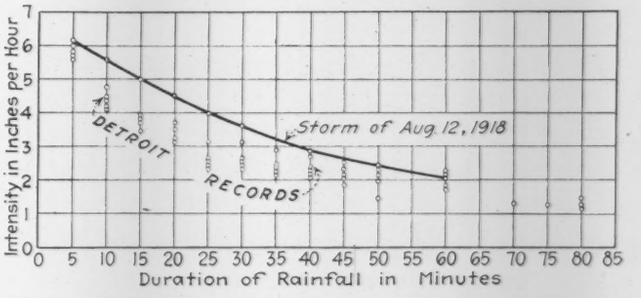
Record Rainfall at Highland Park

BY GEORGE H. RUHLING
Resident Engineer, Filtration Plant, Highland Park, Mich.

WHAT is believed to be a record rainfall intensity for Michigan fell in Highland Park, Detroit, on Sunday, Aug. 12. The storm, following a drought of six weeks, broke at 3:48 p.m., accompanied by a high wind and much electricity, and was at its height at 4:35, stopping at 6:38.

The accompanying table and diagram were compiled from the gage register which has recently been installed on the roof of the Highland Park city hall by the city engineer, and from records of the United States Weather Bureau at Detroit.

That the excessive rainfall was quite local in char-



HIGHLAND PARK RAINFALL ON AUG. 16 EXCEEDING DETROIT RECORD FOR PERIOD 1896 TO 1915

acter is shown by the fact that the United States Weather Bureau at Detroit, only 5½ miles away, recorded only about ½ in. of total rainfall.

Much damage was done in Highland Park. A large

RAINFALL AT HIGHLAND PARK, MICH., AUG. 12, 1918

Duration of Rainfall, Min.	Amount of Rain, In.	Intensity, In. per Hr.	Occurring From	To
5	0.51	6.12	4:32 p.m.	4:37 p.m.
10	0.93	5.58	4:28	4:38
15	1.25	5.00	4:28	4:43
20	1.50	4.50	4:25	4:45
25	1.66	3.98	4:23	4:48
30	1.80	3.60	4:20	4:50
40	1.90	2.85	4:18	4:58
50	1.97	2.36	4:15	5:05
60	2.01	2.01	4:15	5:15
Total	2.21			

number of cellars were flooded with water backing up from the sewers, which are built on the combined plan. In some streets the water reached a depth from 12 to 15 in. It was, in a way, fortunate that the water could not get into the sewers faster than it did, as the damage through backing up into cellars might have been much greater. The filtered water reservoir for Highland Park, now being constructed, was filled with flood water from the Davison Ave. sewer to a depth of 15 in. About 350,000 gal. of water had to be pumped back into the sewer before construction could go on.

Steps Toward an Ethical Standard for Engineers

Adopt Definitions—Resist Exploitation of and By Engineers—Stop Trying To Shift Just Burdens

DURING the year since its organization, the committee on professional ethics of the Cleveland Engineering Society has made a thorough study of codes of professional ethics prepared by doctors, lawyers and architects as well as by engineers. It hopes to publish in time a booklet wherein all the material found needful for the society will be presented in concise form, together with specific "Do's and Don'ts" and specific instances of violations of standards. At a recent meeting of the society David Gaehr, chairman of the committee, made some remarks on engineering ethics. They are summarized as follows:

Obviously, a logical and fair classification of men engaged in engineering should be made at once, approved by the national and local societies and brought home to the public. Those who have been styling themselves engineers without being eligible to membership in the profession should be forced to discontinue the use of the title.

Eliminate Engineering Parasites

If those able to produce evidence entitling them to be called engineers will band together in a way that should make all professional men feel at home, then the craftsman, tradesman and engineer parasite may be eliminated from the field of professional engineering. Then and then only can we look forward to a new era for the engineer, an era in which he will pursue a dignified calling the primary object of which will be service to humanity and the secondary object a livelihood. By coöperation through their national society architects have accomplished remarkable results in the way of gaining improved public esteem and bettered financial returns. Physicians and lawyers have taken advanced stands and controlled their interests. None of these professions would countenance many of the conditions under which the engineering labors heavily.

We would urge that members of the Cleveland Engineering Society agree on definite standards to which a man must conform before he may call himself an engineer. Such standards should emphasize not only technical qualifications but also, and as strongly, those of character. If a man would be called an engineer and be a member of the Cleveland Engineering Society he should be bound in honor by the standards of ethics adopted by our society, irrespective of his business relations or employment. Inasmuch as the enforcement of a code of ethics pertains especially to the local societies, we should bring the subject to their attention, requesting their coöperation in a nation-wide endeavor to raise the standing and standards of the profession.

Marshal Forces Not to Attack But to Resist

The next step is to eliminate from within those things which undermine self-respect. For instance, certain public and commercial enterprises have been quick to recognize and exploit the vulnerable side of engineers, so that methods of obtaining business which at one time may have brought temporary gain for a few have developed to such magnitude as to make it increasingly hard for honorable men to apply their talent in the practice of their profession in exchange for reasonable compensation. We must marshal our forces, not to attack, but to resist, in concert, the common practice of exploiting engineers, as well as to stop once for all the reproachable activities of some engineers whereby other members of the profession and the public fail to receive a square deal. It is plainly wrong from a business standpoint for any high-grade man to render services gratuitously except in emergencies or for obviously charitable reasons. Charity extended in a business way is a farce, and nothing has undermined the standing of the profession more than the placing of services free of charge at the disposal of prospective clients. Everyone knows that only a small percentage of proposal work ripens into contracts. Hence, for all "charity" work the wrong man pays, and in the end the public suffers injustice.

Financial Burden on Client or Contractor

Although vested with great responsibility in large enterprises, the engineer leaves to the client or contractor the financial burden of failure due to his faulty specifications or design. This is typically expressed in the so-called "grandfather clause" providing that if specifications and drawings contain any omissions the contractor shall make them good without charge.

A committee on ethics does not lack standards, but its work is to bring them home to individuals in instructive and forceful manner. "If ye know these things, blessed are ye if ye do them," must be reinforced by the penalty provided for infractions of stipulated restrictions and obligations.

June Collections of Camp Wastes

Garbage and allied wastes collected at army camps in June by the Conservation and Reclamation Division of the Quartermaster Corps totalled 13,391,809 lb., divided as follows: Fats and tallows, 30,435 lb.; bones, 486,927 lb.; other garbage, 12,011,353 lb. Old metal, rubber, rags, bottles, lumber and various other wastes collected aggregated 4,837,647 lb., of which 1,679,855 lb. were sold for $53,049, the remainder being turned over to army organizations for various uses. Manure amounting to 44,054 tons was collected and sold for $11,908; 1043 tons of hay and straw waste brought $5879; and miscellaneous wastes yielded $9294. Revenue from garbage is not reported. The grand total of wastes of all sorts collected in June was 19,649,882 lb.

Build Permanent Pavements at New Aëronautical Station

Town-Site Roadways of Concrete Have Sub-Base Throughout At Langley Field Station—Special Templet Is Used for Warped Crown

By Samuel H. Lea
Hampton, Va.

EXCEPTIONALLY strong pavement construction for the traffic expected at Langley Field town site, Hampton, Va., includes a concrete slab of 7 in. average depth laid upon a 3-in. cinder sub-base. Unlike many of the Government stations which have sprung up on account of the war, this new aëronautical experiment station is being constructed along permanent lines. The topography of the country being very flat, various means were employed to break up the monotony of the landscape, and a layout of driveways resembling park practice resulted. Because of the flat grades, it was found necessary to obtain drainage by deepening the gutters, and the templet used to drag longitudinally the warped concrete surfaces thus formed is of novel construction.

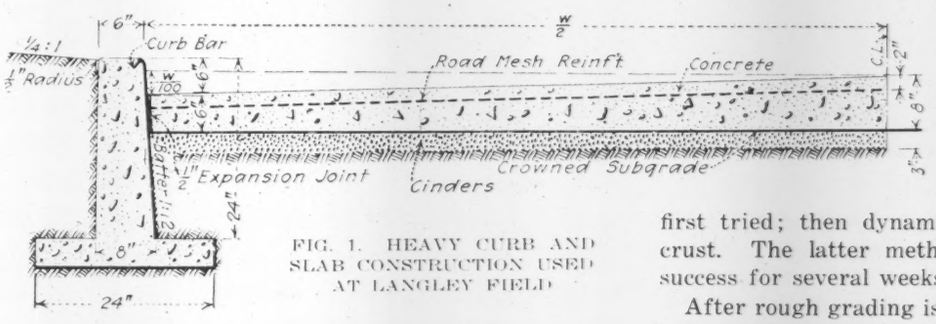


FIG. 1. HEAVY CURB AND SLAB CONSTRUCTION USED AT LANGLEY FIELD

The field is situated on a low-lying peninsula ranging in elevation from 6 to 9 ft. above mean low tide, and is practically flat. The soil is alluvial and proximity to the coast and low elevation make it wet and spongy. This condition, combined with frequent rains, raises the ground-water level to within 2 to 4 ft. of the surface, and at times necessitates considerable pumping in the pavement excavation. When once drained, however, the soil gives a good foundation.

There are about five miles of streets in the town site, requiring 69,000 sq.yd. of pavement. There are 50,350 lin.ft of curb and about 40,000 cu.yd. of roadway excavation. On account of the curved alignment of the streets, numerous irregularly shaped intersections are necessary. This makes difficult form work and pavement finishing necessary.

Because of its special construction with footing, the curb is built before the pavement proper is built; in fact, before the roadway is excavated. A half section of the pavement and curb is shown in Fig. 1. The curb trenches are dug with a trenching machine mounted on caterpillar tractors. The footing, 24 in. wide and 4 in. thick, is built of 1:3:6 concrete. The curb is constructed in 5-ft. sections of 1:2:3 concrete, and has premolded expansion joints ½ in. thick at 50-ft. intervals. Steel curb bars protect the exposed corners. A small gasoline mixer, using one bag of cement to the batch, mixes the concrete footing, and a steam mixer, of 14-cu.ft. capacity, is used for the curb. Fig. 2 shows the completed curb layout at a boulevard intersection.

The street crowns are laid out a few inches below the general ground level, requiring shallow but fairly uniform excavation, for which three steam shovels are employed. These have dippers of about ½ cu.yd. capacity and do excellent work in the shallow cutting. The excavated material is either deposited back of the curb or loaded into bottom-dump wagons and hauled away. The shovels travel on mats which are moved ahead as the work progresses. Great care is taken to prevent the dipper from striking the completed curb. In the past winter the ground was frozen to a depth of several inches, and two methods were used for removing the frozen material. Building bonfires to thaw out the ground was first tried; then dynamite was used to break up the crust. The latter method was followed with limited success for several weeks.

After rough grading is completed fine grading is done by hand, the surface being compacted with a 5-ton steam roller. The subgrade is covered with boiler cinders to a depth of 3 in., when rolled. These form a better sub-base for conditions here than crushed stone or gravel. Fig. 3 shows the fine grade before rolling, while Fig. 4 shows the roadway after the sub-base is spread.

Sand and gravel are delivered on the field by rail, loaded by mechanical loaders into bottom-dump wagons and hauled to the work. Portland cement, conforming to standard specifications, is received by rail, hauled to the work by motor trucks and deposited along the curb. Washed gravel and sand, of good quality and well graded, are used for the aggregates.

The flat grades make it necessary to provide surface drainage for the pavement by means of gutter grades. These are formed by deepening the gutter while keeping the center line at a fixed height with relation to the

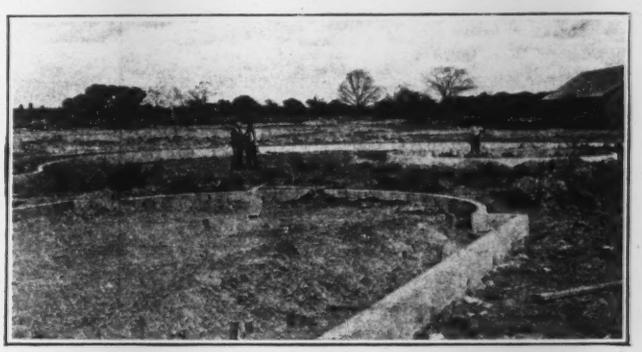


FIG. 2. CURVED ALIGNMENT AT AËRONAUTICAL STATION MAKES CURB CONSTRUCTION DIFFICULT

curb. Catchbasin gratings at the low points alternate with the gutter summits, giving a minimum gutter grade of 3 in. per hundred feet. The pavement has a circular crown, the rise from the gutter to the center varying with the width of the paving and the distance from the

FIG. 3. FINE GRADING COMPLETED READY FOR ROLLING

catchbasins. The center of the road is generally made 1 in. below top of curb.

On account of the warped surface produced by these conditions, it was impossible to drag the surface longitudinally with the ordinary stiff templet. To overcome this difficulty a trussed templet with movable strike-board, designed to conform to the variable crown at all points, was developed. It was made in two sizes for the different widths of roadway. The complete design of this templet and a description of its use will be found in "Hints for the Contractor" for this issue. Fig. 5 shows this templet in operation directly behind the concrete mixer.

The roadway concrete is laid in one course in the proportion of 1:2:3, and is reinforced with No. 25 road mesh placed 2 in. below the surface. The reinforcement is placed on a layer of freshly spread concrete and spreading continues with the templet mentioned above. Before concrete is placed in the roadway the subgrade is checked and all inequalities are eliminated. In dry weather the sub-base is sprinkled, and at all times the concrete is mixed fairly wet, but excessive use of water is discouraged. Two concrete gangs are being used to expedite the work.

At street intersections the center line is 1 in. above the normal grade. At the corners, where the groin lines meet the curb, gutter summits are formed from which the water flows both ways to the catchbasins. Grade stakes are set about 6 ft. on centers on the center and groin lines, and are connected by screeding strips from which the concrete is struck off with short, straight edges, the strips being removed as soon as possible and the spaces filled with fresh concrete. In this way the surfaces are more exactly formed than is possible by the stake and lute method.

The finisher's bridge used on the 24-ft. and 32-ft. roads is shown in Fig. 5, in the foreground. The bridge is mounted on small wheels and rolls on top of the curb. It is simple in design and rigid enough to support three men clear of the concrete. The finisher, working from the bridge, follows the striking templet at a time interval depending upon the weather. He first uses a wooden hand float, and follows this with a darby or long, narrow hand float, which removes considerable excess water from the concrete, pushing it over the surface of the pavement to the gutter. The darby has worked very well in the absence of a roller to remove the excess water. An illustration shows the finisher using this tool.

Transverse expansion joints, protected by steel plates cut to the exact crown of the street, are spread from 25 to 35 ft. apart. At street intersections joints are placed at the point of curve of the curb, and separate the intersection from the rest of the pavement. The joints are $\frac{3}{4}$ in. wide and are filled with premolded joint filler which extends through the entire thickness of the pavement. Longitudinal expansion $\frac{1}{2}$ in. thick is placed along each curb line. For the transverse joints, the filler projects about 1 in. above the surface and the concrete is finished square against it by means of a divided float, which straddles the joint. Filler and plates are assembled, and installed in the usual manner, tops of armor plates being set about $\frac{1}{4}$ in. below the surface of the concrete. The installing device is removed from the armored joint as soon as the concrete has set sufficiently to finish the surface.

The water-supply for the field is obtained from a local water company through a 6-in. main. A large proportion of the supply is used locally, and only a limited amount is available for concrete work. After numerous vexatious delays because of lack of water, it was decided to use ground water for the mixer. This is obtained from convenient wells and basement excavations by means of gasoline pumps.

The completed pavement is protected for about three weeks, while curing, by a shallow covering of earth which is kept wet, after which it is removed and the pavement opened to traffic. The finished pavement has a good appearance, being free from waves and having no large cracks.

Careful records are kept of each day's work for each mixer, the notes being tabulated as shown in Fig. 6, which contains the complete data for a typical day. A

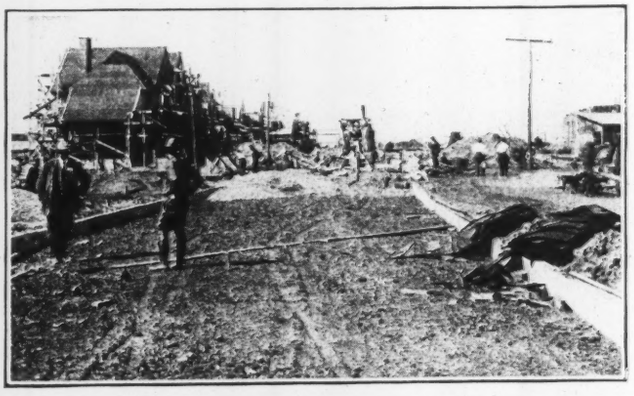


FIG. 4. CINDER SUB-BASE SPREAD AND CONCRETE MATERIALS DISTRIBUTED

graphic record showing the exact location of the work and other data is also plotted, and a weekly progress report is kept on a map of the town site.

The accompanying statement of cost contains figures that are high when compared with prices for similar

FIG. 5. TRUSSED ADJUSTABLE TEMPLET AND FINISHING BRIDGE BEING USED AT LANGLEY FIELD

work before the war, but which are not excessive, considering present conditions and the high quality of the work.

COST PER SQUARE YARD OF COMPLETED PAVEMENT

Cement, 1.4 sacks	$0.588
Sand, 2.8 cu.ft.	.182
Gravel, 4.2 cu.ft.	.392
Reinforcement, joints, etc.	.358
Hauling and unloading material	.400
Water for mixing	.050
Labor, overhead and percentage	1.500
Total cost per sq.yd.	$3.470

Work was started Nov. 27, 1917, and continued until Dec. 8, when the concrete paving was discontinued on account of severe weather. The work of excavating the roadbed was continued through the winter, and some work was done during that time on the concrete curb. On Feb. 25, 1918, paving work was resumed and has continued ever since. The work is now almost completed.

The construction is being carried on under the direction of the Department of Military Aëronautics.

LANGLEY FIELD				DATE Oct. 3, 1918.
ROAD	C1 – J1			
LENGTH 124'	THICKNESS 6" to 9"		MIX 1:2:3	
WIDTH 23' to 26'	SQ. YDS. 344		CEMENT FACTOR-BBLS 1.75	
C. A. Washed Gravel			VOIDS 40% to 45%	
F. A. Washed Sand			VOIDS 35% to 45%	
CONCRETE PLACED-STA. 25+30	TO STA. 26+54		% COMPLETED	
NO. SACKS USED 525	NUMBER REQUIRED 518		% SHORTAGE EXCESS	
COMPOSITION OF SUBGRADE Cinders		PREPARATION 5-ton Roller		
DRAINAGE Storm Sewer		CURING Cover with earth-Sprinkle		
MIXER NAME AND SIZE Foote - 22			REV. PER MINUTE 16 REV. PER BATCH 16	
TEMPERATURE - MAX. 74°	MIN 52°			
REMARKS Reinforcement - #25 Road mesh.				
Joints 31' apart, protected with armor plates				
Elastite Joint filler 1/4-in x 6" to 8"				

FIG. 6. RECORD OF THE PERFORMANCE OF THE PAVING GANG FOR A TYPICAL DAY

Col. William Lay Patterson, Signal Corps, U. S. A., is post commander, Lieut. J. McInerny, S. R. C., is in charge of construction and Lieut. W. H. Scott, S. R. C., is in charge of roads. The J. G. White Engineering Corporation was contractor for the work up to Aug. 10, H. J. Upson being superintendent and the writer road engineer.

Kentucky Undertakes Road Maintenance

State participation in highway improvements in Kentucky, which hitherto has been limited to assistance in the construction of new roads, has now been extended to cover maintenance. The recent General Assembly passed without a dissenting vote a bill which authorizes the State Commissioner of Public Roads to determine the standard of maintenance for roads which are constructed with state aid. Failure of county authorities to maintain roads in proper condition will forfeit their county's share of state-aid funds for new construction, and such funds may be expended by the commissioner in bringing the state-aid roads up to the prescribed standards. Previous to the passage of this bill all maintenance had been in the hands of local authorities. Notice of the provisions of the law has been sent to county road engineers, county judges and other local officials, and beginning with the season of 1919 maintenance work will be carried out before any new construction is attempted. A large mileage of roads has been built under state-aid since 1915, and it is hoped that the counties will carry out the necessary maintenance. If failure to do this is shown by the reports of division engineers of the Department of Public Roads the department will undertake the work. The policy will be to concentrate on maintenance rather than construction during the war. Rodman Wiley is commissioner of public roads.

Elimination of Idleness by Systematic Study

Graphic Charts Show Significance of Increase in Efficiency by Reducing Machinery Idleness Among Industries

By Charles Whiting Baker
Consulting Editor, Engineering News-Record

NEED for intensive production in every industry, which has extended so far that idleness has now been made a statutory offense in several states, makes the systematic study of idleness in industrial organizations of special importance. Every engineer knows, at least theoretically, the great advantage of graphic charts over tables of figures in enabling the mind to grasp the significance the figures contain. In a number of war industries extensive use is being made of graphical records to make clear the causes which may be operating to cut down maximum output.

The value of such charts in studying the operations of an industry, making evident the opportunities for increasing the output and reducing the cost has been brought before the profession by Henry T. Gantt, in papers read before the American Society of Mechanical Engineers. Mr. Gantt has used this method for some time in his work as a consulting engineer for industrial plants.

Efficiency engineering, so called, has placed its chief emphasis on obtaining a larger output from the individual workman, but Mr. Gantt deserves credit for calling attention to the great opportunities for increasing output by decreasing the idleness of machinery. The substitution of automatic machines for hand labor has gone so far that there is as much need for systematic records of the "time-keeping" of these machines as for the workmen whose names appear on the payroll.

It is well understood that in no industry can all the machines, tools and equipment be worked at full capacity all the time. In an industry making a standard product, such as shoes, cotton cloth or plows, some approach may be made to keeping all the mechanical equipment working continuously at full capacity; but in most productive enterprises variation in output is part of the working condition, and the "peak of the load" must be provided for. It is nevertheless most valuable to the executive heads of an industry to have a continuous record of what the various units which make up the plant are doing, and especially of how much of their time they are standing idle.

Charts may be made for individual departments of a plant, and nothing is more common in manufacturing industry than to have heavy losses incurred by the over-development of some one department at the expense of the others, often without the fact being fully realized by the men in responsible charge. Charts of the type of that here shown tell such a clear story of what is going on in a plant—the cost of those standing idle when they should be running, and what departments or machines are worked to capacity and must be supplemented in order to increase output—as to recommend more extensive use than at present.

In order that the charts shall give a correct record, careful study must be given to the method of obtaining the rate of idleness expense chargeable to the different machines or departments. The general method of obtaining this is to ascertain first the cost of maintaining the different machines, benches and work spaces in condition for operation. Under this head are included interest on first cost, taxes, maintenance and depreciation, including an allowance for obsolescence on the buildings, machines and tools. All these items may be summarized as rent, since they include what would be charged to rent if the plant were leased.

To the sum thus found there must be added the expense of supervision—first, of the plant as a whole, and second, of the individual department. This is a part of the operating expense. If a tool or department is idle, this expense must be divided among the tools or departments that are working the same as the expense for rent of land or buildings is charged. The result in either case is to increase the cost of product. The cost of supervision must therefore be included in order to make up an accurate estimate of the loss incurred due to an idle machine.

When the total rate per hour of idleness expense has been computed for each important tool or department, it is a simple matter for the cost clerk to enter daily on the chart the idleness expense from the time cards turned in for each individual tool by the workmen.

The classification of the causes to which the idleness is due is an important part of the system, and is made on the cards turned in by those in charge of the various machines. Thus the manager has placed before him daily or weekly, not merely the lost time of each of the various units which make up his plant, but the principal causes of this lost time. He is therefore able to act intelligently in taking measures to reduce lost time so as to increase output and reduce cost.

The application to construction work through the use of the daily records of the working time of such ma-

CHART SHOWS MONTHLY ITEMIZED COST OF UNAVOIDABLE AND AVOIDABLE IDLENESS

Working Period ..... Weeks 26 Days Period Ending ..... March 30, 1918.

No. of Machines	Machine Class	% Of Capacity Used on Day and Night Turn 10 20 30 40 50 60 70 80 90	Details of Expense of Idleness Due to Lack of Orders	Lack of Help	Lack of Raw Material	Lack of Tools	Repairs	Moving Machines	Total	Expense of Idleness Increase in Unavoidable %	Unavoidable Amount	Expense of Product %	Avoidable	Remarks
10	¾-in. auto screw		$9.40	$26.91	$7.05	$31.68	$114.30	$18.67	$208.01	10	$140.71		$67.30	
4	⅝-in. auto screw		116.64	3.24			132.84	29.16	281.88	10	57.02		224.86	
18	1 in. auto screw		310.28		130.91	26.62	256.46	144.34	868.61	10	432.08		436.53	
4	1¼-in. auto screw		12.88	26.95	161.70		40.04	16.94	258.51	10	67.76		190.75	
29	2 in. auto screw		313.17	13.99	201.33	358.26	2,277.03	1,188.27	4,352.05	10	595.38		3,756.67	
7	2-in. auto screw		224.40		77.84	5.60	38.39	154.42	500.65	10	181.02		319.63	
4	2⅜-in auto screw		9.24	118.27			73.92	44.35	245.48	10	81.31		164.47	
19	2½-in auto screw		169.86	34.20	34.20	231.42	680.58		1,150.26	10	538.38		611.88	
2	Chucking lathes		577.45	14.96			104.72		697.13	5	65.82		631.31	
2	Milling mchs....		41.86				.68		42.54	5	6.02		36.52	
1	Drill press						43.47		43.47	5	2.17		41.30	
Total, 100			1,785.18	238.52	613.03	653.58	3,762.43	1,596.15	8,648.89		2,167.67		6,481.22	

chines as steam shovels, piledrivers, concrete mixers and similar important units is obvious. The added feature of setting down in dollars and cents the daily idleness expense for each machine, with the causes of the idleness, is most important. The mere keeping of such records not only points the way to cut down such expense, but automatically tends to stimulate everyone in responsible charge to reduce idleness wherever possible.

Cost of Service the Chief Factor in Rate Regulation

Rational "Fair Value" Is Held to Be Sum of Interest on Investment and Profit on Operating Expenses, Capitalized at "Fair Return" Rate

BY WILLIAM G. RAYMOND
Dean, College of Applied Science, State University of Iowa, Iowa City

IN A little book, "What Is Fair?", recently published, the author discusses methods of valuation of public utility properties, and finds difficulty in harmonizing court decisions with what appears to him to be rational procedure. Further study of the problem has suggested a method of procedure believed to be wholly in accord with the dictum of the courts: (1) That the utility is entitled to a fair return on the "fair value" of its property used in the service of the public; and (2) that the public may demand that no more be charged for service than the service is reasonably worth. The idea was presented in the book referred to, but was not so fully argued as now; it is based on the following considerations:

1. It appears to be clear from a reading of the Smyth vs. Ames case (169 U. S. 466), in the decision of which the foregoing principles were announced, that the court could not have meant exchange value when it said "fair value," because, as has been said since in other decisions, exchange value depends on earnings, earnings depend on rates, and rates are in question.

2. The court in Smyth vs. Ames did not define "fair value." Courts and commissions have been struggling with the definition ever since, and in an effort to arrive at a quantity that should represent "fair value" have leaned toward "cost of reproduction less depreciation," estimated as of the day of inquiry but estimated according to no fixed rule or method, actually adopting different methods in different cases; sometimes deducting depreciation and sometimes not; sometimes adding "going value" and sometimes not; often finding "going value" by mental processes not capable of satisfactory explanation (see the report of the Master in the Des Moines gas case), and varying the process in other matters. The United States Supreme Court has definitely recognized "going value," as distinguished from development expense, as a proper element of "fair value."

3. The value of the service rendered must be based on its cost, and the utility corporation is entitled to a fair profit on that cost. This furnishes a clew to a definition of "fair value," which is:

Fair value as used by the courts in rate cases is that value the fair return on which provides a fair profit on the cost of the service performed.

4. The cost of the service can be estimated by perfectly clear, logical and defensible methods, with no introduction of hypothetical or speculative quantities.

The procedure would be as follows:

1. Find the sum invested in the plant and fix a fair rental made up of interest, depreciation allowance, insurance and taxes, if taxes are assessed against the physical property.

2. Find the cost of operation, made up of rental, labor and materials, including ordinary maintenance not included in the depreciation allowance.

3. Determine a fair profit rate on the cost of operation and from this the resulting profit sum. In general, the profit rate on the cost of operation should be higher than the fair-return rate on the fair value of the property, and should be fixed to recognize high operating efficiency where this is shown, and with regard to acquired earning capacity as indicated later.

4. The sum necessary to be earned through rates is the cost of operation plus the profit sum on operation.

5. The "fair value" of the investment or property is found by adding the interest on the investment and the profit sum from operation and capitalizing at the "fair return" rate on "fair value."

This method would seem to give that one fair value which so many attorneys and economists have asserted should be found that may be used alike for rate-making and purchase. It recognizes the value of the business, so often called "going value," but finds it in a perfectly clear and logical way, although it is not distinctly separated.

Let an example be given—the interest and profit rates used being purely for illustrative purposes and not suggested as the proper rates for any particular case.

The proper cost of a certain plant, with or without depreciation, according to judgment or facts, is $100,000. Exclusive of rental the annual cost of operation is $20,000. What is the "fair value," assuming that 8% is a fair return on "fair value," and that the company can borrow at 5%? If the company can borrow for 5% it should charge, say, 6% as rental interest. The "fair value" of the investment or property, as derived in the accompanying table, is $111,875. This is not the commercial value necessarily. In the

DETERMINATION OF FAIR VALUE IN HYPOTHETICAL CASE

Rental		
Interest on $100,000 at 6%	$6,000	
Depreciation allowance, say 2½%	2,500	
Insurance, say ½%	500	
Taxes, say ½%	500	
Other cost of operation	20,000	
Total cost of operation		$29,500
Profit, say 10% on operation		2,950
Total fair charges		$32,450
Fair profit	$2,950	
Interest as above	6,000	
Net return		$8,950
Capitalized at 8%		$111,875

absence of other evidence, as discussed later, it is the value upon which 8% is a fair total net return. The commercial value might be more or less, depending on the fixed charges.

If half the investment is borrowed, the payment of interest is $2500 and the balance of net earnings will represent 12.9% on the owner's actual investment.

The Proper Rates

Perhaps it may be argued that the foregoing differences of rates are not determined on a sound basis; that the rate allowed on the physical property should be the same as that allowed on operating expense, and that the latter as a base for profit should be confined to expense other than rental.

If this opinion should prevail the fair value of the investment or property would be the investment in plant plus one year's operating expense, but operating expense should then include depreciation, insurance and taxes, included above in rental. Applying this reasoning to the foregoing example and assuming 8% as a proper fair return, we have

Fair return on plant	$8,000	
Operating expense	$23,500	
Operating profit = 8% of $23,500 =	1,880	
Total return		$9,880
Fair value at 8%		$123,500

or the sum of the investment and one year's operating expense. The value is greater than by the other assumption.

Or it may be advanced that the interest charge should be only at the rate that the company pays, 5% in the foregoing case, but with 8% still allowed as a fair rate of return on the whole property. Under this theory the lessened net earnings in the first case, in which the interest is an item of the cost of operation, would be $1100, and the return to the owner on his actual investment would be 10.7%. Under the second assumption the total net profit would be $6880, and the return on the owner's investment would be about 8.75%, assuming as before that half of the whole investment is borrowed. Which of the several viewpoints should be adopted may be a matter for discussion.

The method suggested is based more upon the second principle laid down in Smyth vs. Ames than on the first, but recognizes the first and gives a fair return on the fair value of the property whether the business is one involving large capital outlay with relatively small operating costs, or small capital outlay with relatively large operating costs. If applied from year to year the method would seem to encourage extravagance in operation, but with rates fixed for a period of years economy of operation would mean the greater return. Where marked efficiency is shown by evidence submitted in any case, a higher profit rate should be allowed in computing the profit on operation.

The method here suggested is founded on the belief that even though it be sometimes true that a property is worth more than the sum that would be found by the application of the principle, and sometimes that it is not worth so much, yet in the normal ideal case the two principles of fair return and fair charges ought to mean the same thing in a valuation.

Some difficulty may be found in estimating the value of the service to the consumer. In a later case (Cotting vs. Kansas City Stockyard Co., 183 U. S. 79) an addition is made to the second principle announced in Smyth vs. Ames; namely, that the value of the service to be considered is the "value of the service rendered to each individual," and not the value of the service to the customers in the aggregate. This addition is argued at some length and seems to be announced as a general principle; but an interpretation given it by the Supreme Court of the State of Maine helps some. In the case of Brunswick and Topsham Water District vs. Maine Water Co., 99 Maine, 371, the justice says:

"In the aspect now being considered, the worth of a water service to its customers does not mean what it would cost some one individual, or some few individuals to supply themselves, for one may be blessed with a spring and another may have a good well. It means the worth to the individuals in a community taken as a whole. It is the worth to the customers as individuals, but as individuals making up a community of water takers. In the very nature of things, a water system is usually intended to supply a somewhat compactly settled community, or a community whose geographical limits are somewhat restricted. . . . Such a community must in general stand as a whole. The rates for such a system are generally and properly uniform, although the expense of supplying some, as those nearer the source of supply, is actually less than that of supplying those at the outermost limits. Still, the benefits are uniform and uniform rates are reasonable."

Individual Consumers, Not the Aggregate

This instruction of the Maine Supreme Court appeals to the engineer as sound and as an entirely proper interpretation of the dictum of the United States Supreme Court, that the test of reasonableness of rates to the customer is reasonableness to the individuals and not to customers in the aggregate. Thus one difficult question is disposed of but another is left, seemingly scarcely less difficult; that is, What is the reasonable worth of the service to the individuals as a community? And here the Supreme Court of Maine helps again. The preceding quotation was based upon or followed these enlightening sentences:

"We do not doubt that when the worth of a public service of this kind to the public or customers is spoken of, necessarily one of the elements to be considered is the expense at which the public or customers as a community might serve themselves were they free to do so, and were it not for the existence of the practically exclusive franchise of the supplying company. . . . In estimating what it is reasonable to charge for a water service—that is, not exceeding its worth to the consumer—water is to be regarded as a product, and the cost at which it can be produced or distributed is an important element of its worth. It is not the only element, however. The individuals of a community may with reason prefer to pay rates which yield a return to the money of other people higher than the event shows they could serve themselves for, rather than make the venture themselves and risk their own money to loss in an uncertain enterprise."

Here seems to be justification for the method of approach suggested in this paper, a method based on the second of the two fundamental principles laid down in the Smyth vs. Ames case, the worth of the service to the consumer, and on an interpretation of that prin-

ciple essentially identical with that stated by the Supreme Court of Maine.

Computations made as in the illustrative examples above given do not necessarily give the final fair value, but they give what may be called the primary or principal basis on which fair value rests. It may be that higher rates to individuals than rates based on cost of service can be shown to be entirely reasonable, and when this is possible and is done, and such higher rates are in force, the value of the property may be more than the estimate based on cost and an assumed profit rate will show unless the profit rate assumed has been selected with this consideration in view. On the contrary, it may well be—indeed, it is known to be in some cases—that rates based on cost of service and an assumed reasonable profit are more than can be charged; are more than the traffic will bear. When this is so the value of the property is less than is shown by the cost of service plus the assumed profit; then it may be, and in some cases is, actually less than the investment, and sometimes has been only salvage. But it still remains true that the owner ought to be permitted by the public to earn at least a fair profit rate on the reasonable cost of service if he can do so; that is, if the business will stand the tax, as it will in the case of every needed and properly planned and operated service.

Comparison with Other Methods

Emphasis heretofore has been almost if not quite universally placed on the first principle laid down in the Symth vs. Ames case; namely, that the utility owner is entitled to a fair return on the fair value of its property used in the public service. Many enormously expensive litigations have grown out of the attempt to apply this principle. Many differences of opinion have developed. The court has implied in its decisions that cost of reproduction of the property at the time the question arises is the best basis of fair value. It has further implied that the property changes in value from day to day with the fluctuation of prices of the materials and labor that enter into its construction. Yet cost of reproduction as of a given date is a very uncertain quantity and depends on a considerable number of much discussed assumptions about which there is quite general disagreement among engineers and among lawyers. But the assumption that the value of a long-lived public utility property varies from day to day with the fluctuations of the prices of the materials and labor that enter into its construction seems so impossible of adoption in connection with the regulation of rates, and so unreasonable in its application to permanent investments in such properties, as to warrant some consideration. Rates cannot be made anew from day to day. In the nature of the case they must be stable for considerable periods of time, during which prices of materials of which the physical part of a utility property is made may undergo violent fluctuations.

Consider a water or gas property in a moderate-sized community. It could be built within a few months, and a very considerable part of its cost, probably nearly half, is for cast-iron pipe. If the plant had been built in 1904 when cast-iron pipe was quoted at about $19 a ton, and valued in 1907, when pipe was quoted at about $31 a ton, and if half the outlay was in pipe, the value of the property because of the change in the prices of pipe alone would show more than a 25% increase over the investment, while the very next year, when the price of pipe dropped to $20 the value would drop to about that of the investment. And the pipe was not of constant price through any one whole year. The pipe in the ground has an estimated life of from 50 to 100 years. The plant is a long-lived plant. Rates may be changed once a year as taxes are, but this is of doubtful wisdom, and five-year intervals are more common for municipal utilities. Shall a large part of an investment made in 1907 be destroyed in 1908 by a public regulation of rates to fit the temporary 1908 prices of materials that were purchased in 1907? Or shall the public be taxed to pay the high rates based on the temporary 1907 prices of long-lived materials purchased in 1904? The reasonable answer seems to be "No."

Fluctuations in Operating Costs

Any such property as is being considered, when it has been in existence long enough to be called an old property, will have parts purchased in times of high prices, parts purchased in times of low prices, and parts purchased in what may be called times of normal prices. The company cannot sell its pipe in times of high prices as the merchant sells his merchandise. What it would cost the community to serve itself with its own plant would not vary with the prices of the materials that entered into the construction of the fixed plant. The money that it would borrow to build the plant would bear a constant rate of interest throughout the life of the bonds issued. When materials are consumed in operation, the variation in the prices of these materials does affect the cost of operation and may affect the value of the property if rates are not changed from year to year to correspond, and for this reason it may be wise to fix rates annually. But by allowing a slight margin in rate fixing, the larger profits in times of low prices will be offset by the smaller profits in years of high prices, so that, except in such very abnormal times as the present war times, adjustment of rates may well be at longer intervals.

It may be true in a certain theoretic economic sense that the value of any composite changes with the changes in the prices of its constituent elements, with the changes in the interest rate on money, etc. But with respect to long-lived stable properties of the public utility class, there seems to be no practical reason for varying rates with change of prices of the materials that enter into the construction of the physical property involved, except as by long-continued and perhaps permanent rise or fall in prices, replacements shall have materially increased or diminished the actual investment in the property. The investment will always be shown by properly kept accounts, and may be estimated fairly well in spite of poorly kept accounts. Therefore, it is submitted that the true basis of value of a public utility property is actual investment or estimated actual investment, increased as it may be by the effect of a fair profit on the cost of the service that the investment and the franchise have made possible, and increased further, when proper evidence is produced, by the effect of reasonable but higher rates than those computed

from assumed profit rates; or diminished by the effect of rates that are all that the traffic will bear but are lower than those computed from assumed profit rates.

The conclusion of this discussion is that reasonableness of rates must be determined more by cost of service than by hypothetical values of involved property; and that value for rate making, purchase or taxation should be based more on the fair profit that may be earned on the cost of the service performed than on hypothetical estimates of reproduction cost with going values added, for the estimated amounts of which no reason can be given. The method is thought to be a rational method, in harmony with a proper interpretation of the law as expressed in the decisions of the United States Supreme Court, and quite worthy of the careful consideration of valuation experts, whether lawyers or engineers.

Five and a Half Million Yards Dredged by Large Fleet at Hog Island

Schedule Kept by Careful Planning in Spite of Severe Winter and Interference with Pipe Lines From Progress of Work Ashore

ALTHOUGH the unusually severe winter stopped the operation of floating plant after but 300,000 yd. of the total 5,500,000 had been dredged at the site of the Hog Island ship plant, and although progress of work ashore by the time the river was free of ice had blocked the laying of pipe lines from certain areas and made necessary the replanning of the work, the dredging has been kept up to schedule and has already progressed so far that it will be possible to launch and fit out the ships as fast as they can be assembled. The work has been carried on with four to five hydraulic dredges, one used entirely for rehandling, six to seven bucket dredges and one to three dipper dredges, most of the excavation being disposed of in three impounding basins on the property.

Where Excavation Lay

From the ends of the fifty launching ways to the 18-ft. contour 870,000 yd. had to be removed, leaving a bottom which slopes from 12 ft. at the ways to 18 ft. below mean low water at a distance of 235 ft. out. Most of the yardage, however, lay in the fitting-out basin and around the seven piers and one wharf being built there. At the east inshore end of this basin was a small triangular area from which it was possible to remove something less than 100,000 yd. in the dry during the winter. A 400-ft. channel in the fitting-out basin and extending to deep water in the river had to be dredged to a depth of 30 ft. below mean low tide, while the berths between two of the easterly fitting-out piers were made of the same depth. The remainder of the fitting-out basin was dredged to a depth of 18 ft. below mean low water. The yardage taken out to this depth amounts to 3,850,000 yd., while that removed below the 18-ft. depth will come to 780,000 yards.

There are three impounding basins on the property, which will not hold quite all of the yardage to be removed. The Henson basin at the east end of the launchways has a capacity of 500,000 yd., while the north basin, lying back of the launchways, the shops and the storage yards, will receive about 1,600,000 yd. The largest basin, at the west edge of the property, was formed by building crib dikes out across the old Essington Channel to some shoals between Hog Island and Tinicum Island. This basin will contain upward of 2,360,000 yd. Its construction necessitated the dredging of a new Essington channel between the basin and Tinicum Island. However, as the building of the dikes changed the direction and force of the tidal currents and has caused considerable scouring on the shoals mentioned, the dredging of the new channel has been left to the last and will not involve more than 100,000 yards.

Work Delayed During Severe Winter

A hydraulic dredge began work soon after the contract for the yard had been awarded last fall, off the easterly group of ten launchways, and pumped 300,000 yd. into the Henson basin before ice in the river made it necessary to lay up the equipment. It had been planned to pump all of the dredging from before the ways directly into this basin and into the north basin, but by the time the ice broke up in the spring construction on the launchways, the shops and the yards had progressed to the point where it would have been inefficient to attempt to maintain a pipe line across them. The remainder of this excavation, therefore, was completed with dipper and bucket dredges, and the Henson basin was filled by dumping the spoil from the bucket dredges at the suction of a 30-in. hydraulic dredge which rehandled the material. It was necessary to leave a bank near the shore and to support the cofferdams within which the outboard ends of the launchways were constructed, and this material will be some of the last to be removed on the work.

Winter Forces Change of Plan at Fitting-Out Basin

It had been intended to put the hydraulic equipment at work first on the three fitting-out piers and the east portion of the 30-ft. channel, where the bulk of the dredging lay, and pump as much as possible of this material into the north impounding basin. Ice, however, prevented work at this point until the middle of March, and all that could be done was to remove the high part of the excavation to within 1 ft. of low tide. This was done by a traveling derrick with a grab bucket and the spoil was carried away in railway cars.

During the winter, however, a drag-line excavator and a steam shovel completed the dikes around the north impounding basin. Much of the material used was frozen hard, and some difficulty was experienced with the dikes later on this account. When it became possible to use the hydraulic dredges, the west classification yard and some of the shop buildings had progressed so far that a pipe line could not be laid directly from the center of the heavy dredging, and it was necessary to move the 30-in. rehandling dredge from the Henson basin to a point west of the deep excavation in the fitting-out basin, from which a line could be run to the north impounding basin. The deep dredging at the east end of the fitting-out basin was, therefore, completed with dipper and bucket dredges, while the hydraulic equipment was concentrated on the 18-ft. dredging at the west side of the basin, with two of the remaining four machines pumping into the north basin and the other two into the west basin.

The bucket dredges were used to clear out as rapidly as possible the site of the piers so that piledriving could proceed. This was done by driving a certain number of the pier piles with floating equipment to support track for two-way land piledrivers which completed the work. This dredging progressed so well that the shore bulkhead and the four easterly piers had been practically completed by the middle of July, and a large number of piles driven for the next two piers.

Old Stone Dike Removed

A stone dike reaching from the west end of the launchways to a point within the site of the west impounding basin which had been built some time previously extended for a good part of its length to 8 ft. above mean low water. It was necessary to remove 1300 ft. of this dike, cutting a 1000-ft. gap at the east end of the basin and a 300-ft. gap at the west end. This work was done by a 5-yd. dipper dredge which did not take part in the other operations, the stone removed being used to complete the portion of the dike left in place to full height.

The dikes around the west impounding basin, a considerable length of which were located in water 12 to 14 ft. deep, were made of timber cribwork, built and sunk in place in long sections against guide piles, filled with sand pumped by one of the dredges and banked with riprap on the outside to prevent scour from tidal currents. This work, which was begun toward the end of the winter and completed in May, was carried out by the Bates & Rogers Construction Company.

Large Number of Dredges Used

For a time five hydraulic dredges, a 15-in., an 18-in., a 20-in., a 22-in., and a 30-in. machine, were on the work. The largest dredge was used entirely for rehandling, and the small dredge and the 22-in. dredge mainly for handling material in the west basin. The other two dredges pumped directly into the north basin. These machines were all of about the same type, having a pump speed of 250 to 275 r.p.m., and carrying 40 to 50 lb. pressure in the discharge line with a velocity of about 10 ft. per sec. Three of them are still on the work. There are now five bucket dredges and two dipper dredges at the site, the latter of 3 and 3½-yd. sizes. A 3 and a 3½-yd. bucket dredges were also on the work for a time, while there still remain a 2½ yd., a 3½-yd., a 5½-yd. and three 7½-yd. bucket dredges. When running at full capacity the nine bucket and two dipper dredges supplied about 14,000 yd. a day to the 30-in. rehandling dredge, a quantity considerably below its capacity.

All the bucket dredges except the small one, and all the hydraulic dredges, have operated 24 hours a day, the crews living aboard the dredges.

Up to the present the scow haul to the rehandling dredge has been short, two scows to a bucket dredge being sufficient. Five tugs and fourteen scows supplied by the dredging contractor have been on this work, while the hydraulic dredges have been handled when it was necessary to move them by tugs belonging to the American International Shipbuilding Corporation. A considerable part of the yardage, however, will have to be towed away from the site and disposed of by the contractor in private basins. This will make it necessary to increase the number of tugs and barges when the present basins are filled and the large dredge is removed.

The 20-in. and 22-in. hydraulic dredges were rented on the basis of handling 6000 yd. a day, while the 18-in. dredge was expected to handle 4000 and the 15-in. dredge 2500. Allowances were made for varying conditions of digging, but in the sandy mud with a small percentage of gravel which formed the bulk of the work these averages were maintained. The bucket dredging work was contracted for on a straight yardage basis including the service of the dredges, tugs and scows.

The dredging work was carried out for the American International Shipbuilding Corporation, agents of the Emergency Fleet Corporation, by the American Dredging Company.

Determining the Regulating Effect of a Storage Reservoir

Differential Equation for Inflow, Outflow and Storage Relations Solved by Using Time Interval as Independent Variable

By Robert E. Horton
Consulting Hydraulic Engineer, Albany, N. Y.
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IN MOST flood-regulation cases arising in practice the thing to be determined is the maximum stage which will be reached where the rate of inflow to the reservoir varies continually and where the area of water surface also varies with the depth on the spillway. A new method is here offered for this determination, one that is easier than any before available.

If I is the rate of inflow to a storage reservoir at any moment, Q the rate of outflow, and S the corresponding rate of gain or loss of storage at that instant, A being the area of the reservoir surface and H the depth of water above spillway level, then

$$S = A\frac{dH}{dt}$$

$$\text{also } S = I - Q,$$

$$\text{and } Q = CLH^{\frac{3}{2}}$$

The differential equation to which these functions lead is not capable of direct general integration in such a manner as to give H directly in terms of T. Various solutions of this equation have, however, been by series and by graphical methods.

For a small rise dH in water-surface level during the time interval T, the volume relations between inflow, outflow and storage are expressed by the formula,

$$IT = A\,dH + \frac{Q_1 + Q_2}{2}T$$

where Q_1 and Q_2 are the rates of outflow from the reservoir at the beginning and end of the time interval T. The quantities A, Q_1 and I being given, either T or dH can be determined by a process of trial and error or successive approximations if the other quantity is assumed. In the solution of this problem dH has generally been assumed, as it would appear at the outset that this would lead to a simpler solution of the problem than if a time interval T was assumed for the purpose of determining dH.

So far as the writer is aware, the earliest application

of this method to the determination of the regulating effect of a storage reservoir is given by Lieut.-Gen. J. Mullins in his "Irrigation Manual," published for the Madras Government in 1890 (pp. 215 to 223 in the section on "Reservoirs, Their Influence as Flood Regulators"). This publication is not generally available in this country. However, the formulas of General Mullins and the solution of a problem of flood regulation for a proposed storage reservoir on Genesee River are contained in the reports of the late George W. Rafter on Genesee River Storage ("Report of the State Engineer and Surveyor of New York" for 1894, pp. 390-392; and continued in the report for 1896, pp. 722-724).

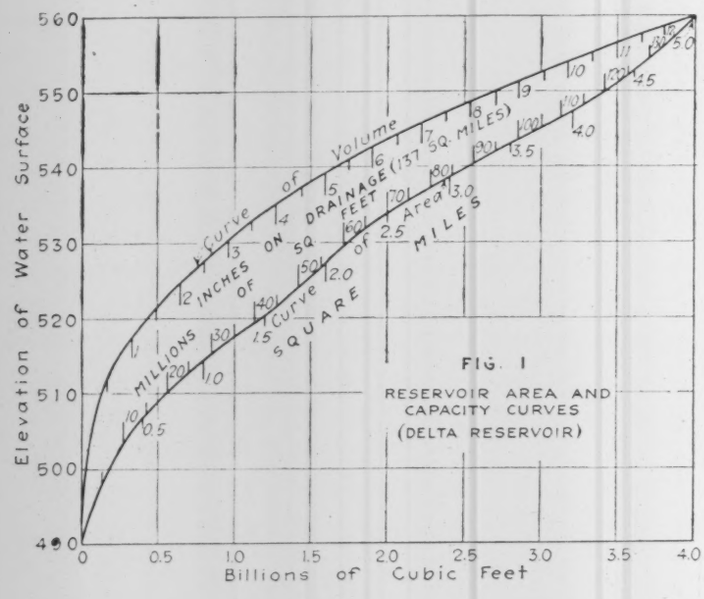
A similar solution of the problem involving the assumption of a series of values of dH for the purpose of determining the time T by a process of trial and error was developed by Glenn D. Holmes, and used by him in a study of flood regulation of proposed New York State Barge Canal reservoirs in 1906. Another solution of the problem in which the computation is simplified by the use of an auxiliary function curve is given by H. K. Palmer in *Engineering News* of Mar. 21, 1912, pp. 524-525. Mr. Palmer's method involves the mechanical quadrature of the function curve which he uses. It also depends on a process of successive approximations for the determination of T and is complicated in case the inflow rate I is variable. Other solutions are suggested by T. R. Running in *Engineering Record* of Jan. 17, 1914, pp. 67-68, and by A. S. Fry in *Engineering-Contracting* of Apr. 19, 1916, pp. 369-372.

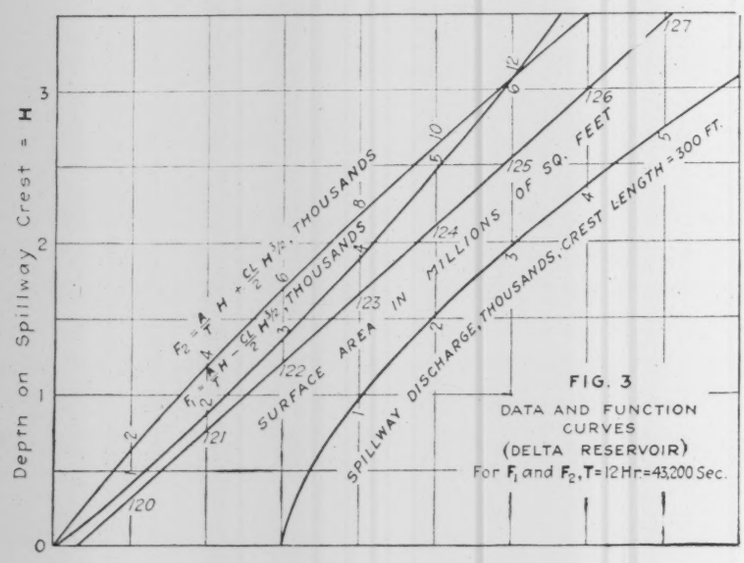
In connection with the design and construction of a small storage reservoir on Oneida Creek in 1901, the writer conceived the idea that the solution of this problem could be simplified by assuming T as the independent variable in the equation given above and solving for dH. In this solution, the determination of H for any chosen time interval, T, is made dependent upon the equation of values of two special functions. Curves of the values of these functions can readily be computed and plotted for any given reservoir, after which the solution of any problem of flood regulation by this reservoir can be very simply obtained.

TABLE I. COMPUTATION OF AUXILIARY FUNCTIONS FOR DETERMINATION OF FLOOD REGULATION BY SPILLWAY DISCHARGE

Head on Spillway H	Area Above Spillway A	$\frac{A}{T}H$	C	$H^{\frac{3}{2}}$	$\frac{CL}{2}$	$\frac{CL}{2}H^{\frac{1}{2}}$	$F_1 = \frac{AH}{T} - \frac{CL}{2}H^{\frac{3}{2}}$	$\frac{CL}{2}H^{\frac{3}{2}}$	$F_2 = \frac{AH}{T} + \frac{CL}{2}H^{\frac{3}{2}}$	$Q = CLH^{\frac{3}{2}}$
0.5	120,440,000	1,395	3.33	0.35	500	175	1,220	1,575	350	
1.0	121,550,000	2,815	3.50	1.00	525	525	2,290	3,340	1,050	
1.5	122,650,000	4,260	3.55	1.84	532	979	3,281	5,239	1,950	
2.0	123,740,000	5,725	3.60	2.83	546	1,530	4,195	7,255	3,060	
2.5	124,860,000	7,220	3.65	3.95	547	2,165	5,055	9,385	4,330	
3.0	126,000,000	8,750	3.70	5.20	550	2,865	5,885	11,615	5,730	

Length of spillway crest = L = 300 ft.; length of period = T = 12 hr. = 43,200 sec.; C = variable coefficient of discharge for spillway




Depth on Spillway Crest = H
SURFACE AREA IN MILLIONS OF SQ. FEET
SPILLWAY DISCHARGE, THOUSANDS, CREST LENGTH = 300 FT.
FIG. 3
DATA AND FUNCTION CURVES
(DELTA RESERVOIR)
For F1 and F2, T=12 Hr=43,200 Sec.

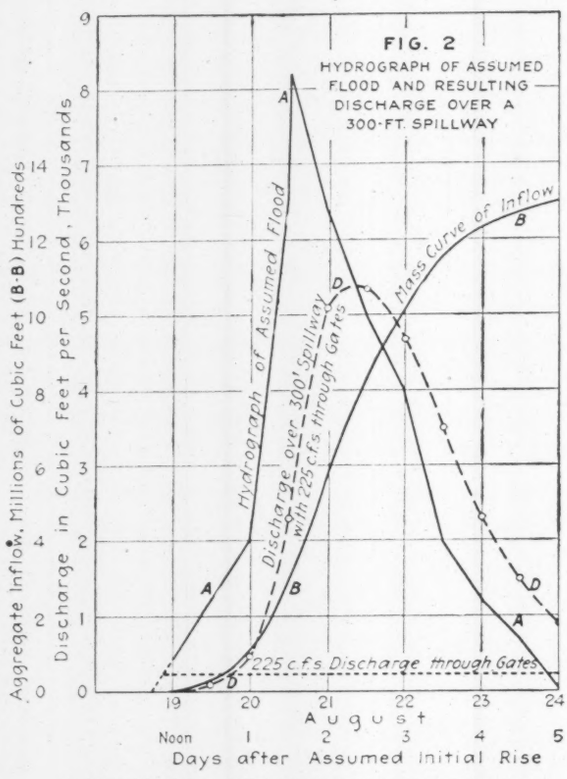


FIG. 2
HYDROGRAPH OF ASSUMED FLOOD AND RESULTING DISCHARGE OVER A 300-FT. SPILLWAY
Aggregate Inflow, Millions of Cubic Feet (B-B) Hundreds
Discharge in Cubic Feet per Second, Thousands
Hydrograph of Assumed Flood
Discharge over 300' Spillway with 225 c.f.s. through Gates
Mass Curve of Inflow
225 c.f.s. Discharge through Gates
August
Days after Assumed Initial Rise

CURVES FOR REGULATING RESERVOIRS

TABLE II. COMPUTATION OF FLOOD REGULATION BY SPILLWAY DISCHARGE FOR CONDITIONS IN FIG. 2.

Date	Hour	Length of Period T	Inflow at Beginning of Period	Mean Inflow for Period I	Outflow Through Gates K	Head on Spillway—Start of Period H_1	F_1	$F_2 = I - K + F_1$	H_2 = Head on Spillway—End of Period	Discharge Over Spillway at End of Period
Aug. 19	Noon	12 hours	425	812	225	0	0	587	0.20	100
	Midnight		1,200	1,600	225	0.20	520	1,895	0.61	480
20	Noon	=	2,000	5,100	225	0.61	1,450	6,325	1.76	2,500
	Midnight	43,200	8,200	7,300	225	1.76	3,800	10,875	2.82	5,200
21	Noon	seconds	6,400	5,700	225	2.82	5,530	11,005	2.86	5,320	
	Midnight		5,000	4,500	225	2.86	5,650	9,925	2.63	4,670
22	Noon		4,000	3,000	225	2.63	5,250	8,025	2.18	3,500
	Midnight		2,000	1,600	225	2.18	4,530	5,905	1.67	2,300
23	Noon		1,200	950	225	1.67	3,600	4,325	1.27	1,510
	Midnight		700	375	225	1.27	2,830	2,980	0.92	920
24	Noon		50	50	225	0.92	2,130	1,955	0.62	500

This method of solution of the problem is direct: *i.e.*, it eliminates the process of trial and error or successive approximations which are used in all the other methods described. It is also much simpler in application if the necessary function curves have been computed.

In the following paragraphs the theory is given on which the method is based, together with an example illustrating its use. A convenient form of area and capacity curve for a large reservoir is shown by Fig. 1.

Several cases of flood control by a reservoir are: (1) Reserve storage to retain entire flood inflow; (2) reserve storage to retain inflow excepting a nearly constant outflow through gates; (3) reserve storage below spillway to retain partial inflow with or without constant discharge through gates, remainder wasted over spillway; (4) reservoir full to spillway level at start.

In order to determine the reserve storage required to control a given flood in Case 2 plot a hydrograph of the flood and determine the area above the ordinate corresponding to the discharge rate through the gates. For example, with the flood shown in Fig. 2, and a constant outflow through gates of 225 cu.ft. per second, the necessary storage reserve to prevent waste over spillways (*i.e.*, to regulate outgo to 225 sec.ft.) would be as follows: Total volume of flood, 1,277,000,000 cu.ft.; volume in excess of 225 sec.ft. required storage, 1,182,000,000 cubic feet.

In Case 3, a mass curve of the inflow, or the inflow less the outflow through the gates, if any, may be used to determine the time at which the reservoir will become filled to crest level, Fig. 2, line B. After the spillway level is reached, the further determination of the regimen of the flood below the reservoir may be accomplished as follows:

Let H_1 and H_2 be initial and terminal heads on the spillway crest for any chosen unit period time.

Then the average rate of discharge in second-feet during the unit period is

$$CL\frac{H_1^{\frac{3}{2}} + H_2^{\frac{3}{2}}}{2}$$

The average rate of gain or loss of storage in second-feet is

$$\frac{A\,(H_2 - H_1)}{T}$$

Where T = time unit, seconds;

L = length of spillway crest, feet;

C = coefficient in weir formula (if variable, use mean of values for H_1 and H_2);

A = mean surface area of reservoir between H_1 and H_2, square feet;

I = mean rate of inflow to reservoir during time T, second-feet;

K = rate of outflow through gates, etc., if any, second-feet;

We have for time T; *Rate of Inflow = Rate of Gate Outflow + Rate of Spillway Outflow + Rate of Gain (or — Rate of Loss) of storage.* Substituting symbolic values we have:

$$\frac{CL}{2}H_2^{\frac{3}{2}} + \frac{CL}{2}H_1^{\frac{3}{2}} + K + \frac{A\,(H_2 - H_1)}{T} = I \qquad (1)$$

Transposing to get terms containing H_2 in the left-hand member, we have,

$$\frac{CL}{2}H_2^{\frac{3}{2}} + \frac{A}{T}H_2 = I - K + \left(\frac{A}{T}H_1 - \frac{CL}{2}H_1^{\frac{3}{2}}\right) \qquad (2)$$

Letting $\left(\frac{CL}{2}H_2^{\frac{3}{2}} + \frac{A}{T}H_2\right) = F_2$, and

$$\left(\frac{A}{T}H_1 - \frac{CL}{2}H_1^{\frac{3}{2}}\right) = F_1$$

Equation 2 can be written, $F_2 = I - K + F_1 \qquad (3)$

F_1 and F_2 are functions of H. A series of values of each is computed for chosen values of H, and curves plotted showing the relation between H, and F_1 and F_2. (See Fig. 3.)

For the first period, starting with the water surface at the elevation of the spillway crest, $H_1 = O$, so that $F_1 = O$. I and K are known and F_2 is found from Equation 3. With F_2 determined, the corresponding value of H_2 can be taken directly from the F_2 curve (Fig. 3). For the next period $H_1 = H_2$ of the period preceding and the corresponding F_1 is found on the F_1 curve and Equation 3 again solved for F_2, after which the procedure is the same as before.

The following example is taken from a calculation of the effect of the New York State Barge Canal Reservoir at Delta, N. Y., in regulating the flood shown by the line A, Fig. 2. The reservoir is assumed full to spillway level at noon on Aug. 19; the spillway crest is 300 ft. long; there is a constant discharge through gates of 225 sec.-ft. At midnight Aug. 20, H has been found to be 0.20 ft. For the following 12-hr. period, H_1 will equal 0.20 and the corresponding $F_1 = 520$ from the curve. The average inflow for the period equals 1600 sec.ft.; $F_2 = I - K + F_1 = 1600 - 225 + 520 = 1895$, from which $H_2 = 0.61$ = head on spillway at noon and equals H_1 of the following period. For a precise calculation the end of the next time unit should be coincident with the maximum.

As a check on computation: *Total Storage + Area Value Under Curve of Discharge = Area Inflow Curve.* The discharge over the waste weir corresponding to each value of H_1 and H_2 being computed, a set of diagrams may be plotted showing in terms of time: (1) Rate of inflow to reservoir; (2) rate of outflow from reservoir; (3) depth of waste weir.

Computations should be carried beyond the point of maximum outflow. The diagrams show directly the reduction in maximum discharge volume and the lag or delay in run-off occasioned by the reservoir.

The less the spillway length, the greater, as a rule, will be the range in depth on the crest and the consequent regulation. When the initial stage is below the spillway crest, the gates opened at beginning of rise and closed when the water reaches the spillway level will sometimes give the best regulation and the greatest reduction in flood volume below the reservoir.

The accompanying tables show details of the computation of the function curves (Fig. 3) and also of the regulated-flood hydrograph, Fig. 2, line D. It is sometimes convenient to use two sets of curves for F_1 and F_2, one set for a short time interval for low heads, and the other set for a longer time interval for greater heads or depths on the spillway.

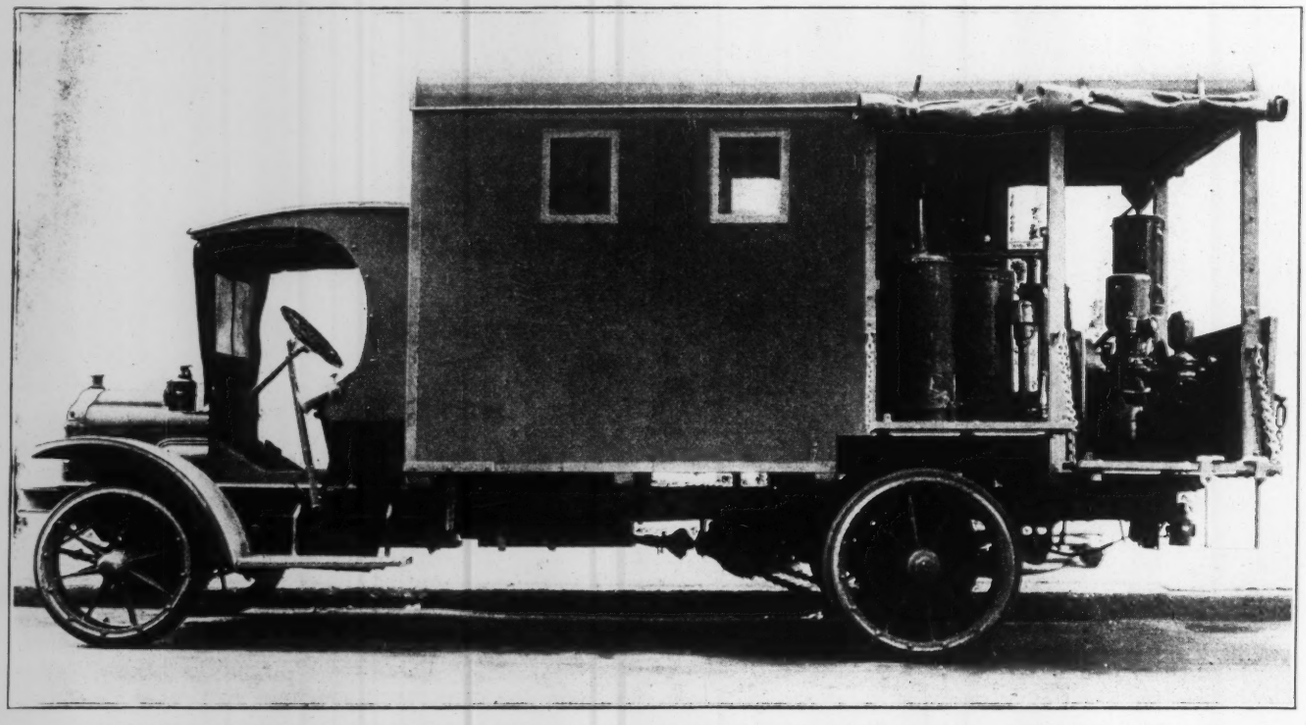
Army Motor Trucks Carry Water Purification Plant

Provided with Mechanical Filter, Chlorinating Apparatus and Testing Laboratory, They Insure Safe Water for Troops

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

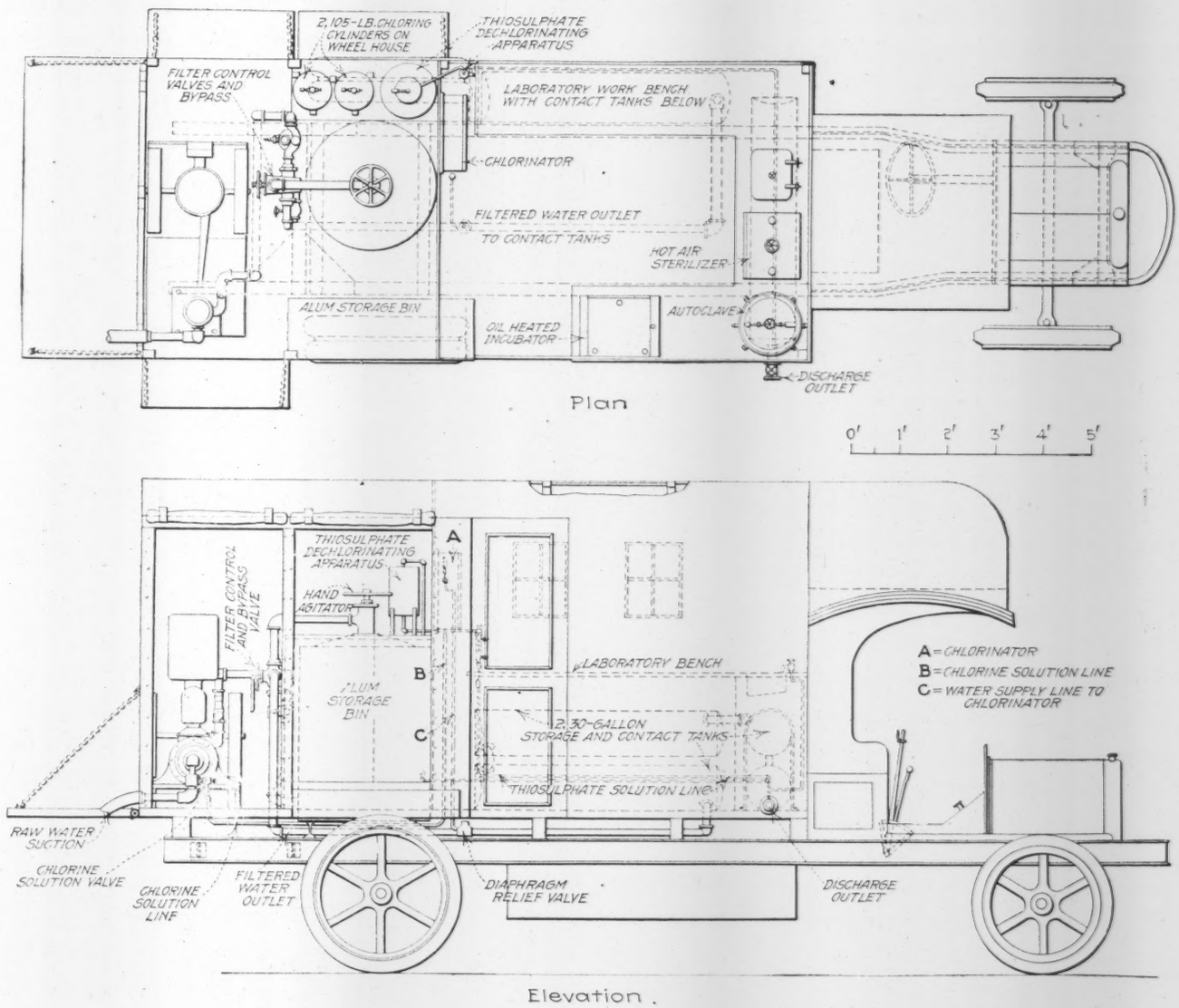
For emergency filtration, sterilization and analysis of water supplied to American troops at the front in France, specially designed mobile plants, mounted on standard motor trucks, have been placed in service. The first outfits of this sort were sent to a division in an American sector early in June. They are the forerunners of others which, it is planned, will be used pretty generally by the American Expeditionary Forces for producing temporary supplies of potable water pending the creation of the more or less permanent "water points" which present military engineering practice has developed for the advance zones. While they embody no principles of water treatment which have not been employed for years past in the United States, the portable plants are nevertheless unique in so far as sanitary engineering practice of the allied armies is concerned. They represent an ingenious adaptation of standard American methods of water purification, on a comparatively large scale, to the special needs of Army service, the features of the new outfits being mobility and such compactness in arrangement that a complete water purification plant and analytical laboratory are carried on the chassis of a 3-ton truck.

There are at the present time three different types of these motor-truck plants. The first is known as the "Steri-Lab" and comprises a pump, a pressure filter, a chlorinating apparatus and a laboratory. The second, the "Chloro-Pumping" outfit, is like the first, except that it carries no pressure filter, and has a pump of greater capacity than the "Steri-Lab." The third is essentially a laboratory on wheels for the chemical and bacterial analysis of water. These mobile plants were designed and equipped by the Wallace & Tiernan Co., Inc., of New York, working in collaberation with officers of the Corps of Engineers.



ALL THE STERI-LAB EQUIPMENT IS COMPACTLY ARRANGED AND CARRIED ON A THREE-TON TRUCK

The details of the "Steri-Lab" truck are shown in the



SIDE ELEVATION AND PLAN SHOW DETAIL OF MOBILE WATER PURIFICATION PLANT

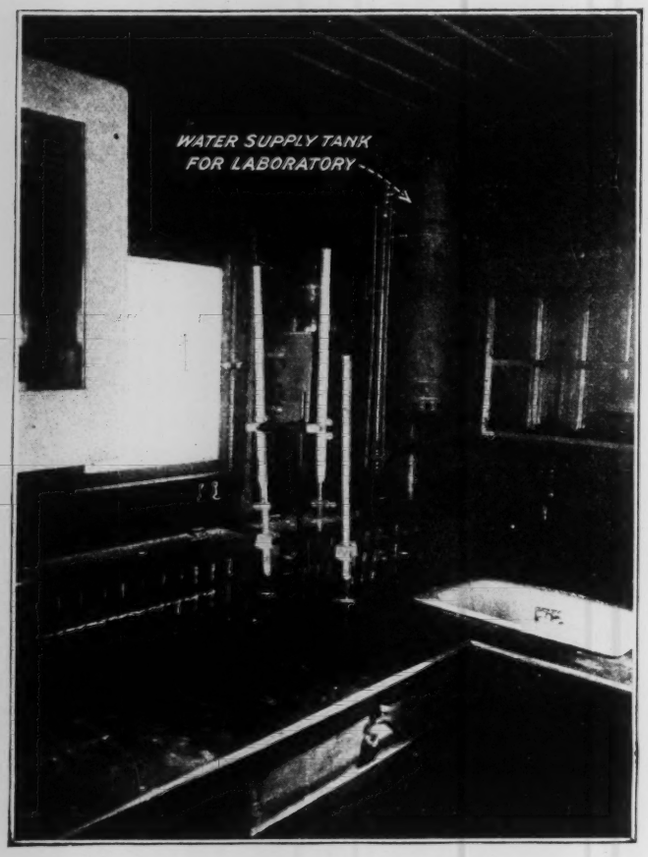
accompanying drawing and photographs. At the rear end is a gasoline-driven pump of the double-acting piston type with a rated capacity of 20 gal. per minute which may be operated against a pressure of 100 lb. per square inch. It is equipped with 50 ft. of 2-in. hose, foot-valve and strainer. The pump delivers direct to a Roberts mechanical filter of the pressure type, a 30-in. diameter vertical tank mounted over the rear axle. This filter has a hand agitator and is fitted with an alum pot. An alum storage bin is mounted over the right rear wheel of the truck.

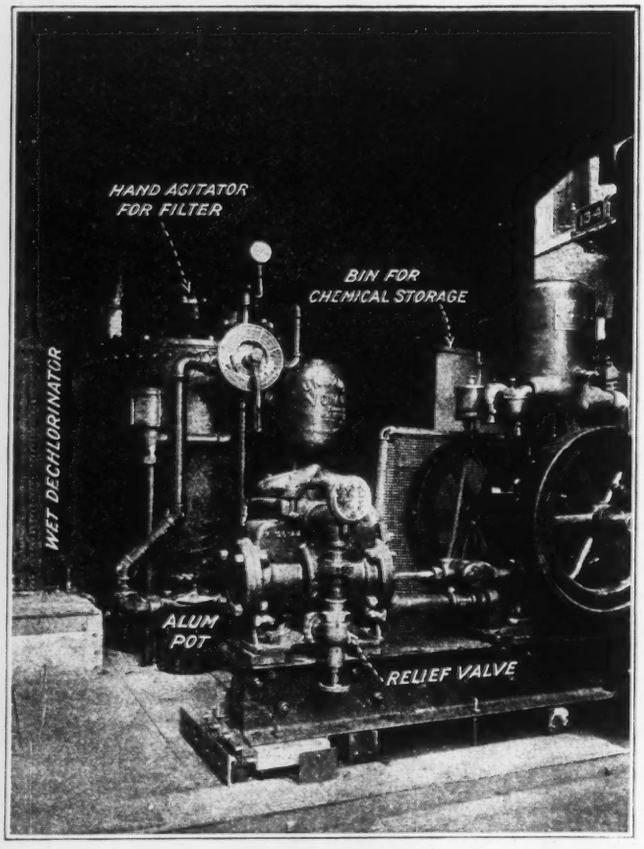
Chlorine gas is applied at the pump suction, and the dose generally is much heavier than that employed in ordinary municipal water-works practice. It may vary from 4.5 to as much as 10 parts per million. A contact period of from 10 to 15 minutes is afforded by cylindrical tanks mounted under the work bench of the laboratory compartment of the outfit. With such an intensive application of chlorine, which is adopted to insure absolute safety in the quality of the treated water, it will frequently be necessary to dechlorinate with a thiosulphate solution applied through an adjustable sight feed. The chlorine is carried in 105-lb. cylinders. To a large extent our water-supply sterilization will be carried on with chlorine obtained from the gas service of the American Expeditionary Forces.

The filtered and sterilized water passes either to a discharge valve, where it can be fed to tank carts or stationary storage, or it may be left in the contact tanks for storage there. These four tanks have a capacity of 30 gal. each, and are tested for a pressure of 100 lb. per square inch.

The forward part of the truck body is occupied by the testing laboratory. This room is completely inclosed, and provided with a door from the rear and wire-glass windows on the side. It is completely equipped as a water-testing laboratory, with working bench, wash sink, water under pressure through faucets, hot air sterilizer for sterilizing glassware, autoclave, bottle and instrument rack, and a full line of laboratory utensils. The laboratory will be used to test waters before and after treatment and for such tests as are required on other occasions.

This type of machine will be able to sterilize 1200 gal. of water per hour when operating through its full system. A bypass is provided around the filter, so that if





CORNER OF WATER ANALYSIS LABORATORY—PUMPING PLANT, PRESSURE FILTER AND DECHLORINATOR

a water supply is encountered which does not require filtration to remove turbidity and color, but simply chlorination to make the water bacteriologically safe, the capacity may be increased.

The second type of mobile plant, or "Chloro-Pumping" outfit, is carried on a 1½- instead of a 3-ton truck. Here there is no pressure filter. The pump has a capacity (40 gal. per minute) double that of the "Steri-Lab" machine. This outfit is designed for emergency work during an advance or a retreat where filtration may be dispensed with. The chlorinating and thiosulphate apparatus is of the same kind as that previously described.

The "laboratory," or third, type of truck is also carried on a 1½-ton chassis. It is fitted with the usual equipment for making chemical and bacteriological examinations of water. All racks and cases are felt-lined to prevent glass breakage. Water for laboratory use is contained in a tank fitted with a hand air pump to supply pressure. On this truck will be carried a bicycle for the use of the laboratory assistant in collecting samples.

Distribution of Internal Work in Beams and Slabs

Difference in Amounts of Energy Stored in Steel Indicates Dissimilarity in Structural Functions of Concrete

By Henry T. Eddy
Dean and Professor Emeritus, University of Minnesota

THE writer has recently calculated the amount of the energy of elastic deformation expended in elongating the reinforcing steel and in compressing the concrete in the specimen beams cited by Humphrey and Losse in Technological Paper No. 2, U. S. Bureau of Standards, Table 26, page 60; and he has compared these amounts with the total work of deflection due to the action of the load. These beams had seven different steel ratios, from 0.0049 to 0.0196; they were loaded at their one-third points. The calculations are too lengthy for insertion here, but they show that at steel stresses of 16,000 lb. per sq.in. in the middle third the mean energy stored in the steel was 62.5% of the work of the load, and the mean energy of compression of the concrete was 34%, with not over 10% variation from the mean value, while at steel stresses of 32,000 lb. per sq.in. in the steel (whose yield-point was between 35,000 and 43,000) the mean energy stored in the steel was 67% and the mean energy of compression of the concrete was 30%.

These two kinds of stored energy, that stored in the elongation of steel and that in the compression of the concrete, account for so nearly all of the energy expended during deflection that the residue is negligible. Very little energy storage of any kind other than those already considered is possible.

In attempting to make similar calculations respecting flat slabs, the test data available suffice to calculate the energy stored in the steel with considerable accuracy, but do not appear sufficient to furnish a basis for any such satisfactory calculation of the work done upon the concrete during deflection.

A detailed consideration of the test of the Deere & Webber building made by A. R. Lord in 1910 shows that at a mean steel stress of 9000 lb. per sq.in. at midspan the energy stored in the slab steel was 12.6% of the total work of deflection. The test of the Northwestern Glass Co. building made by F. R. McMillan in 1913 shows that at a mean steel stress at midspan of about 17,000 lb. the energy stored in the slab steel was 12% of the work of deflection. The test of the St. Paul Bread Co. building by W. H. Kavanaugh in 1912 shows that the energy stored in the slab steel was 12.8% of the work of deflection.

The present writer's general formulas for stresses and deflections of flat slabs, which have been found to be in good agreement with all test results available up to the present time, give the work stored in the slab steel as 12.7% of the total work of deflection at high test loads. At lighter loading the percentage might differ slightly from this, but the difference is not important.

These results seem to show conclusively that in slabs the percentage of energy absorbed by the steel is much smaller than in beams—say only about one-fifth as much. If so, the stresses in the slab steel are much smaller than they would be by beam theory, lending confirmation to the claim made on other grounds by the writer that they are less than one-fifth as great.[1]

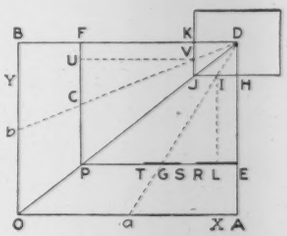
If only one-eighth of the total energy of deflection, then, is stored in the slab steel, the question is, where is the rest of it to be found? It must be found in the concrete, which consequently must play a much more predominating role in flat slabs than in beams, as it is evident that it does in the first place, because the steel ratio in flat slabs is commonly only about half that in beams.

In the opinion of the writer, direct tensions in the concrete parallel to the steel cannot possibly supplement the steel tensions in such a way as to cause the concrete to take four or more times as much direct tension as the steel. That is incredible on the face of it, for were it so the removal of all the steel should not greatly reduce the strength and resistance of the slab. At the high steel stresses in slabs under test it is not possible that any important assistance to the steel should be derived from direct tensile stress in the concrete at points of maximum steel stress, although considerable work may be expended in direct tension of concrete in parts of the slab where the steel stresses are smaller. It would seem impossible that more energy should be expended in direct tension of concrete parallel to the steel than upon the steel itself. That would leave three-fourths of the work of deflection still to be accounted for.

The writer has attempted to give an explanation of the mechanical action of the concrete matrix in holding crossed rods together in "Reinforced Concrete Construction," p. 127, where it is shown how lines of diagonal tension and compression in the concrete form the connection between the reinforcing rods. In this kind of coaction between the steel and concrete in fine-grained reinforcement, energy is expended on the concrete throughout the entire tensile region of the slab in a manner not found in beams.

It must be remembered that in the compression areas of the concrete the compression takes place in two directions at once instead of occurring in a single direction only as in beams, thus storing more energy in compression per cubic unit than in beams for a given intensity of stress.

But there are still other kinds of resistance afforded by the concrete in slabs not found in beams. At midspan of the panel sides there is at the top of the slab longitudinal compression and transverse tension. The two acting at once constitute a state of stress equivalent to a horizontal shear on vertical planes cutting the sides obliquely. Shears of opposite sign occur at the bottom of the slab. The opposite shears constitute twists about horizontal axes that are oblique to the sides of the panels.



QUARTER PANEL OF FLAT SLAB, COLUMN CENTER AT D

But these twists, arising directly from the action of the longitudinal stresses of the bending moments, are not the most important and generally diffused twists that exist in the slab. For, let *OADB* in the sketch be a quarter panel of a uniform continuous plate with center at *O* and center of column cap *HKJ* at *D*, uniformly loaded. The edges *AH* and *BK*, the median lines *OA* and *OB*, and the diagonal *OJ* are all lines of zero shear at all points. The total load on *AOJH* is supported by the vertical shear at *JH*, and the total load on *BOJK* by the vertical shear at *JK*. The shear on *JH* is equal and opposite to the sum of all the shears on parallel vertical sections like *PE*. If *W* be the total panel load outside the caps, then the upward shear at *JH* is $\frac{1}{8}W$, and the downward resultant shear of the load on *OAHJ* is $\frac{1}{8}W$ applied at its center of gravity *G*. Lay off *TS* and *RE* each equal and parallel to *JH*, and suppose the resultant downward shear of the load to act at *TS*. Let upward and downward shears of the same amount be applied at *RE*. Since these last constitute a system in equilibrium they can be added to the system already existing at will. The upward shear at *JH* and the equal downward shear at *RE* constitute a bending moment about the axis *OX* of amount $\frac{1}{8}W \times IL$. The upward shear at *RE* and the downward shear at *TS* constitute a twisting moment about *OY* of amount $\frac{1}{8}W \times GL$. The load $\frac{1}{8}W$ upon *OAHJ* is carried to the cap and fully supported there by these shears and moments and produces no other shears or moments. Similarly the load $\frac{1}{8}W$ on *OBJK* produces a bending moment about *OY* of $\frac{1}{8}W \times UV$, and a twisting moment about *OX* of $\frac{1}{8}W \times CU$. But $GL = \frac{1}{2}UV$ and $CU = \frac{1}{2}IL$. Hence the statical moment of the load about either axis is one-third twisting moment and only two-thirds bending moment.

Twisting moments cause no longitudinal stresses in the slab as do bending moments. Hence, however small the cap may be, the bending moment due to two quarters of a panel can never exceed two-thirds of $\frac{1}{8}Wl$ and for a cap of size $0.2l$ the bending moment is found to be less than $\frac{1}{16}Wl$.

[1] "A Further Discussion of Steel Stresses in Flat Slab Floors," American Concrete Institute, twelfth annual convention, Chicago, February, 1916.

The large applied twisting moments on sections parallel to *PE* and *PF*, which have heretofore apparently been entirely overlooked, increase in uniform plates uniformly from *E* and *F* to *P*. Resistance to these twisting moments absorbs energy of deflection throughout the entire area of the slab. But in a floor slab the distribution of the resistance is controlled by the relative rigidities of these sections and may increase irregularly.

The above-demonstrated reduction of the bending moment below the value $\frac{1}{4}Wl$, which has been almost universally accepted hitherto, is one of the reasons for the small percentage of energy found in the slab steel. Another form in which slab concrete stores energy is in the twist about vertical axes which can be demonstrated to exist in vertical slab elements that extend through the slab from the top to bottom surface, due to variations of rigidity in resisting twisting moments.

It is perfectly evident from the foregoing cursory examination of the subject, which is not assumed to be exhaustive, that in slabs the concrete is called on to afford resistance in several ways in addition to those represented in beam action. Since the same concrete can simultaneously and effectively fulfill these several functions at one and the same time, it is not surprising that slabs exhibit properties not found in beams and not at all to be accounted for by beam theory. Each separate kind of resistance that is called into play in a slab contributes just so much to its load-carrying capacity and diminishes by just so much other resistances that would be called for, did these not exist.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Heavy Motor Trucks and the Highways

Sir—The discussion, in your issue of July 18, of interurban roads for motor truck traffic, by Samuel Whinery, was indeed an interesting and timely one, as all of us who have any occasion to use the trunk routes for motor travel can bear witness.

Mr. Whinery's discussion brings to mind an experimental piece of track that was laid in Murray St., between Church St. and Broadway, New York City, in either 1899 or 1900. I do not know who was responsible for the experiment, or when or why the track was finally taken up, but it seems to me that it contained the solution of the present problem.

That was, of course, before the days of any great amount of motor traffic, and the purpose of the track was merely to minimize the amount of effort exerted by the horses in moving wagons through a city street, in the same manner that rails minimize the effort necessary to move horse-cars.

The track consisted of two fairly wide and rather shallow channels or troughs of steel, running longitudinally in the street and far enough apart to make a track of proper gage to accommodate practically any wagon or truck that would ordinarily be used in city traffic. Being very shallow, it required little effort to pull out of the track and pass around another vehicle which was met or overtaken, and having passed, to pull back and proceed as before.

I believe that a single pair of these channel or trough-shaped rails could easily be made a part of any new road construction which was intended for a moderately dense traffic, or, in other words, a traffic that is not too dense for "single track" operation. In practice, it would of course be necessary for both vehicles to pull out of the track when meeting or overtaking, in the same manner in which they now pull to the side on hard roads or out of the rut on earth roads, but, by reason of the shape of the rails, this would entail no appreciable effort.

On roads of denser traffic it would, of course, be necessary to provide for "double-track" operation by laying two pairs of rails, and it would then be unnecessary to turn out when meeting. When overtaking, only the faster moving vehicle would need to pull out of the track.

If these tracks were used, it would be advisable to pave the space between the rails and out to the shoulders with concrete, and it would also be necessary to have the rails firmly fastened to and supported by the road construction. Being of steel, they could stand the heaviest type of motor-truck traffic with hardly any wear, and should last indefinitely. At the same time they would relieve the paved areas from the punishment which they now receive, and which soon destroys even the best of them.

As compared with the type of industrial railways suggested by Mr. Whinery, the tracks described above have the advantage of requiring no switches or turn-outs. They do not require additional width of roadway, and they require no more grading than is necessary for any of the types of road now in use. Furthermore, they obviate the need for any special flanges or other attachments to the wheels of the highway vehicles.

From the standpoint of ultimate cost, the addition of one or two pairs of rails to a road under construction should be a comparatively inexpensive matter, since they would make possible a great decrease in the cost of maintenance and a great increase in the life of the road.

Another advantage of this type of track over the industrial track would be that it could be installed in as long or as short sections as financial conditions warranted, and that new sections could readily be linked up to those already constructed.

The exact cross-section of the rail, as well as the method of fastening and supporting it, would require considerable study and possibly some experimentation, but these are only details to be taken up at the proper time.

CHARLES F. DINGMAN,
Flynt Building and Construction Company.
Palmer, Mass.

Copper Sulphate Controls Algae Growth in Tieton Irrigation Canal

SIR:—Since the article by Paul Taylor in your issue of July 25, showing the effect of algae in increasing the value of Kutter's n in the Tieton Canal, was written, we have been able to eliminate this trouble by the use of copper sulphate.

About July 1 of the present year the growth again became sufficient to retard the flow in the canal. Copper sulphate to the amount of 200 lb. was suspended in burlap sacks in the water near the head of the canal. The entire quantity was dissolved in a few hours. A week later, when the canal was again inspected, the growth of algae had entirely disappeared along the water line, where it had been most abundant. It was not feasible to empty the canal, but apparently the entire growth has been destroyed.

The canal was carrying at the time of the experiment about 305 sec.-ft. The velocity in the open channel, where the copper sulphate was suspended, is about 3½ ft. per sec., and in the concrete-lined canal about 10 ft. per second.

Yakima, Wash. R. K. TIFFANY, Project Manager.

City, County and State Plan for Reconstruction

Sir—In view of the editorial in your issue of Aug. 8, with reference to providing work for the returning soldiers at the close of the war, you will no doubt be interested to know that the City of Alton plans to spend $1,000,000 for a city hall, paving and other improvements as soon as the war is over. Our county has authorized a bond issue to build $1,500,000 worth of hard roads at the close of the war. This was carried by a vote of 7 to 1. The State of Illinois will vote Nov. 5 on building $60,000,000 worth of hard roads at the close of the war.

So you can see that our state, our county, and our city certainly agree with you in your recent editorial. The only way to meet the conditions that will prevail at the close of the war is to provide sufficient work for all while the nation is in the process of readjustment.

Alton, Ill. HARRY HERB, Manager, Board of Trade.

National and Local Societies

Sir—For a number of years there has been a very strong sentiment among the engineers resident in the City of Duluth and the mining and industrial territory adjacent to form a local engineering society that would embrace all members of national societies and those who are actively engaged in engineering work and who have not yet joined or are not yet qualified to join such societies. Some of the older men of this locality have held back from organizing such a local society pending the actions of the national societies in laying out a plan that might guide and direct the form and membership of a local—with a view to uniting such locals, when formed, with a national organization.

Nothing having been done yet to point out the proper form of a local that might eventually enter a national, the engineers of Duluth met on Aug. 5 and organized and incorporated the Duluth Engineers' Club. The strength and support of this club will be local members of the great national societies who have practically all joined the club and who will probably constitute more than 50% of its membership. It is the aim of the Duluth club, and it has already been largely accomplished, to bring into its membership all men who are actively engaged in engineering work in and near Duluth. Its "general purpose is to create an instrument by which united action can be obtained by the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual; to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession and in general for the uplift of the community, the profession and the individual."

Such a society, with an eventual membership of three hundred, is now in existence and is willing to coöperate and work with a national organization—but where is the organization?

At the last regular meeting of the Committee on Engineering Coöperation held in Chicago, Mar. 29-30, 1917, there were present official representatives of at least two national societies, who spoke very strongly in favor of not attempting to form a new national organization that would embrace all local engineering societies, but instead to wait until the four national societies could have time to act and present for consideration a plan of organization. As shown by the resolutions drawn at that time by the Committee on Engineering Coöperation, this suggestion was followed, and the result was the presentation, by the four national societies, of the Engineering Council plan, practically a subcommittee of the United Engineering Society.

Studying carefully the charter and by-laws of the United Engineering Society and its committee, the Engineering Council, it is hard to understand how it can possibly function toward correlating the work and interests of local engineering societies throughout the country. It has apparently missed entirely the vital question under consideration by the Committee on Engineering Coöperation.

Many engineers have felt during late years that something should be done to unite all branches and all the different levels of the profession, and that this could be done in a complete and satisfactory manner only by and under the direction of the large nationals. It is vitally important to the well being and standing of the profession, as well as to the public at large, that the many thousands of men who are actively engaged in engineering work and who are not members of national societies, and perhaps never will be, should be brought under the influence of the profession in the best and most kindly way. If this can be successfully accomplished it will tend to remove many points of friction among engineers and build up an *ésprit de corps* among men who have had little interest in their work outside of its immediate financial returns. The local society is the first step toward accomplishing this result; when rightly organized and run it will be

the live nerve end of the profession that comes in touch with the public and will return to its governing head important sensations. Through the professional and social work of these locals the profession may build on a broad and solid foundation, and it never will become stable and solid until conditions at the bottom are sound.

As stated by C. E. Drayer of the Cleveland Engineering Society, "there should be no lowering of the standards of the nationals" and none will be necessary. Rather they might well be raised if there were proper organizations to fill the need now unprovided for. The lack of correlation between locals and some form of national organization will be felt in the coming revision of the constitution of the American Society of Civil Engineers by pressure being brought to bear to open up some lower level of membership that might be better taken care of in the local. If the leading national societies cannot rise to this demand and lay down a plan to provide for the necessity, there will be organized an association for that purpose, and it may well, in a very short time, become—at least in public opinion—the one engineering organization.

Detailed plans whereby the great mass of unrelated and uncontrolled material in the engineering profession could be brought under the Engineering Council should not be hard to arrange. This, if successfully done, would give tremendous strength to its work. The field that could be covered by its public affairs committee and its committee on engineering service would be enormous, and the possibility of intelligent control and direction of these thousands of men, in local engineering societies, by the nationals, would be of untold benefit to the public and the profession.

As stated editorially in *Engineering News-Record*, Aug. 8, several plans have been suggested, and it is squarely up to the profession to solve the question.

W. H. HOYT.

President, Minnesota Joint Engineering Board.
Duluth, Minn.

Is Poor Drainage the Actual Cause of Most Highway Failures?

Sir—Is improper drainage the actual cause of any large percentage of the pavement failures which are an annual occurrence? The frequent reference to poor drainage as the cause of pavement failures leads to the query as to just what "drainage" is and as to what relation it bears to pavement failures.

The first part of this query is readily answered. Drainage, as usually understood is the art of removing gravitational water, and involves the use of ditches to remove surface run-off and the installation of subsurface drains wherever they are necessary for the removal of ground water. But the removal of surface run-off and of ground waters to the level of the subdrainage system does not insure that subgrades will be dry, for all soils absorb moisture readily and retain it persistently. A great deal of the water so absorbed is moved by capillary attraction and capillary attraction is, of course, uninfluenced by drainage systems, except as drainage systems may occasionally lower the level of the water table so far that capillary attraction cannot lift the water into the subgrade. But the water raised into and held in a soil by capillary attraction may be quite sufficient to render it soft and plastic.

Then, again, the advocates of drainage as a curative for all of the ills which befall a modern highway usually overlook the fact that there are a great many soils which, even when saturated, drain very slowly if at all. The writer's attention was recently called to the condition of a pavement on a fill some 12 ft. high. The metaling had failed under heavy traffic and, upon examination, it was found that water stood two inches above the bottom of the metaling. Examination showed that the fill had been tile drained.

This case was not unusual. Everyone knows that many clays are quite impervious—so impervious that they are very commonly used in producing water-tight cofferdams where a few feet of clay is often used to hold back water even against a considerable head. Just why men who know this should try to "drain" these same materials by the simple process of installing a few feet of tile has never seemed quite clear. But even if such clays could be more readily "drained" (and clays comprise a goodly percentage of most subgrades) this would be of small value, for the clays absorb moisture quite readily and retain enough to maintain themselves in a plastic condition for long periods after every protracted rain. But the moisture so absorbed and so retained is not one whit affected by the presence of any sort of drainage system, as every engineer knows. Where clays of this type are encountered, they should be wasted, for they are a constant source of trouble during wet weather.

Last, but by no means least, the advocates of extensive tile drainage seem to overlook wholly the fact that tile drains to be at all effective must be placed three or four feet under the surface of the ground. But in the spring, when subgrade conditions are the worst, subdrains are inoperative because the frozen ground which at this time underlies the surface prevents any water from getting down to them. This should be clear without any comment and, indeed, every drainage engineer who works in the northern part of the United States knows that his tile drainage systems do not begin to flow until two or three weeks after the spring weather has thawed the snow and melted the top of the ground.

There are pavement failures which are due to "improper drainage," but they are comparatively rare—very rare indeed on state road systems. It is, of course, beyond dispute that many road failures could be avoided if the subgrade could be kept perfectly dry, but there is no reason at all for assuming that even perfect drainage systems would keep the subgrade dry. As a matter of fact, they would not accomplish this result. There should, therefore, be a good deal more discussion of the bearing value of soils and their general behavior under the moisture conditions which really prevail in normal subgrades, more of a tendency to analyze pavement failures, and less satisfaction with the superficial explanation that if a pavement has failed there must have been some trouble with the drainage.

J. L. HARRISON,
Highway Engineer.

Falls Church, Va.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

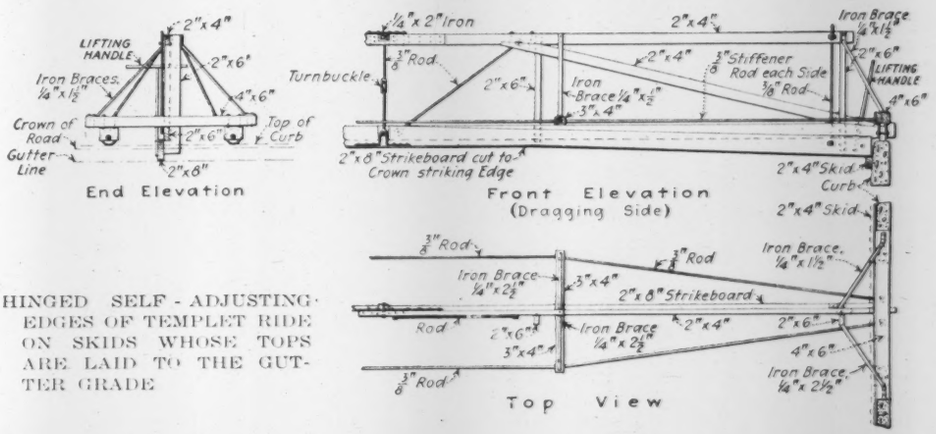
Templet With Adjustable Edges Strikes Variable Crown Pavements

BY SAMUEL H. LEA
Hampton, Va.

A TEMPLET with self-adjusting cutting edges has been developed for striking the warped surfaces of the pavements at the Langley Field Aëronautical Station near Hampton, Va. The level nature of the country makes it necessary to get drainage by dropping the gutters while the center line is held at a uniform elevation with respect to the curbs. This produces a warped surface which cannot be dragged longitudinally with the ordinary rigid templet. A complete description of the conditions surrounding the job at the experiment station and a picture of the templet in operation are given in an article on page 447 of this issue.

Complete details for the construction of the templet are shown in the drawing. The distinctive feature is the strap-iron hinge, at the center, which allows the two sections of the cutting edge to be raised and lowered. Not being attached to the trussed frame, these edges may be easily raised and lowered by means of the two lifting handles. The center hinge is suspended from the truss by a rod and turnbuckle, allowing adjustment for changes in the elevation of the curb with respect to the center line of the street. The cutting edges must be in front of the frame as it moves forward, and the frame must be well trussed and braced laterally to prevent deflection.

In operation the truss, which is mounted on four wheels, rolls upon the top of the curbs, while the cutting edges slide upon skids which are bedded against the curbs at the proper gutter grade. The skids are made in short lengths which may be quickly removed after striking, so that the space which they occupy may be filled with concrete. Four men are required to operate the device. Two move it forward, while two raise and lower the cutting edges so as to tamp the concrete. After the first strike, the edges are raised, the templet is moved back, and the operation is repeated without tamping. This leaves a smooth surface for the finishers.



HINGED SELF-ADJUSTING EDGES OF TEMPLET RIDE ON SKIDS WHOSE TOPS ARE LAID TO THE GUTTER GRADE

Other Articles in This Issue of Interest to Contractors:

American Army's Water-Works Project in France Number About Four Hundred Page 434
Computing the Lateral Pressure of Saturated Earth Page 441
Build Permanent Pavements at New Aëronautical Station Page 447
Five and a Half Million Yards Dredged by Large Fleet at Hog Island Page 454

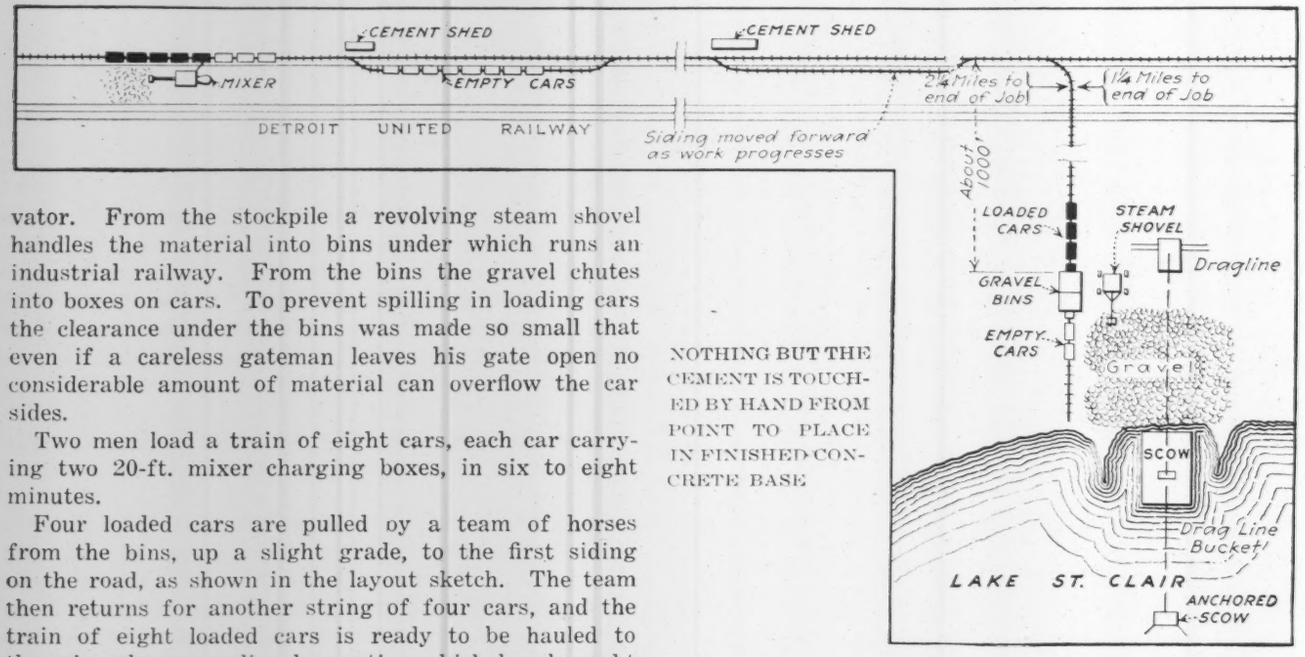
Every Step Mechanical in Materials Supply for Michigan Road

AGGREGATE handling is one hundred per cent. mechanical on the new shore road being built near Mount Clemens, Mich. The train of mechanical processes begins with the unloading of the barges which bring in the gravel, and is continuous to the charging of the mixer. Not a manual operation, except those for actuating the machines, intervenes. All-mechanical handling of aggregate means that six-sevenths of the volume of concrete materials are unloaded, reloaded, hauled and put into the mixer without being touched by hand. Only the cement is unloaded, reloaded and changed by hand.

The shore road is 3½ miles long and 18 ft. wide, and has a 5-in. base of 1:6 concrete with a 2-in. asphalt wearing surface. The volume of concrete per lineal foot of base is, therefore, 7½ cu.ft., or a little more than ¼ yd. About 400 lin.ft. is the average day's run, but as much as 512 lin.ft. have been laid in eight hours. At 400 ft. a day, about 112 cu.yd. of gravel and 450 bags of cement are consumed in a day's work.

Gravel barges, as indicated by the plan, arrive at a point about opposite the middle of the section of road being built. This location keeps at a minimum the length of haul. The service railing extends about 1000 ft. to the road, and then along the side of the road to the place of concreting. It is single-track, with two turnouts. As the work progresses the siding nearest the mixer is moved forward about ¼ mile at a move. The track is built in 15-ft. sections and is easily shifted by hand.

Arriving at the landing stage, the gravel barges are unloaded into a stockpile by a dragline cableway exca-



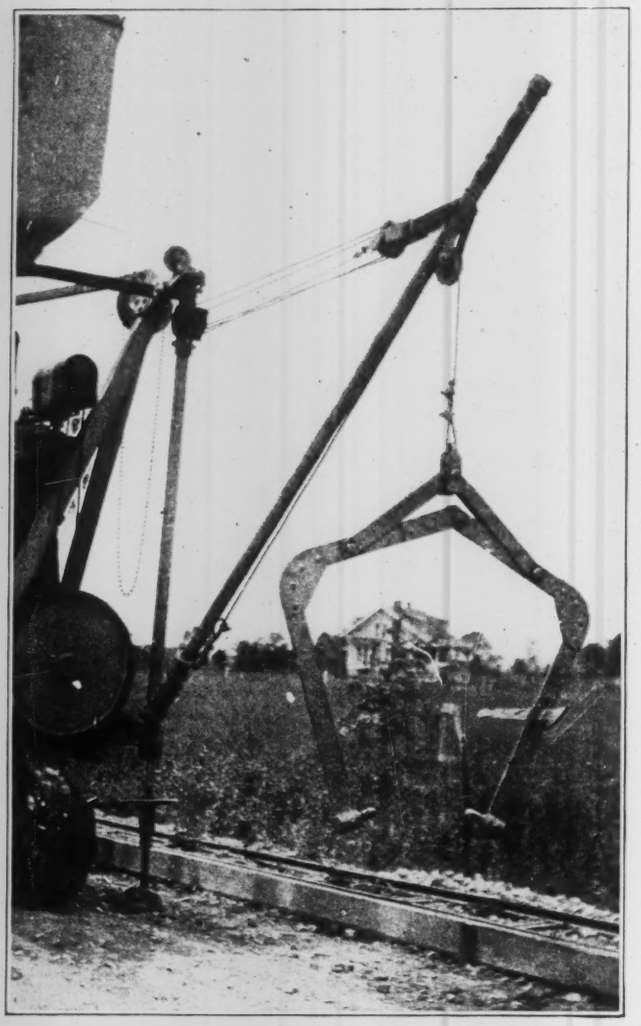
vator. From the stockpile a revolving steam shovel handles the material into bins under which runs an industrial railway. From the bins the gravel chutes into boxes on cars. To prevent spilling in loading cars the clearance under the bins was made so small that even if a careless gateman leaves his gate open no considerable amount of material can overflow the car sides.

Two men load a train of eight cars, each car carrying two 20-ft. mixer charging boxes, in six to eight minutes.

Four loaded cars are pulled by a team of horses from the bins, up a slight grade, to the first siding on the road, as shown in the layout sketch. The team then returns for another string of four cars, and the train of eight loaded cars is ready to be hauled to the mixer by a gasoline locomotive which has brought back a string of empties.

Each car, as previously stated, carries two boxes, each holding 20 cu.ft. of gravel. The mixer is fitted with a batch transfer attachment from which a bail is hung, as one of the pictures shows. This bail is so balanced that it will stay open, thus permitting a train to move under it without the necessity of swinging the derrick. By means of this apparatus a box of gravel is lifted from the car and dumped into the loading hopper. Three bags of cement are then added, and the batch is ready to be mixed. Only five men are needed at the loading end of the mixer, three to discharge a box full of gravel into the hopper and two to handle the cement. The latter was stored in several sheds along the road. It was hauled from the sheds to the mixer in cars, each of which holds 60 bags of cement.

NOTHING BUT THE CEMENT IS TOUCHED BY HAND FROM POINT TO PLACE IN FINISHED CONCRETE BASE



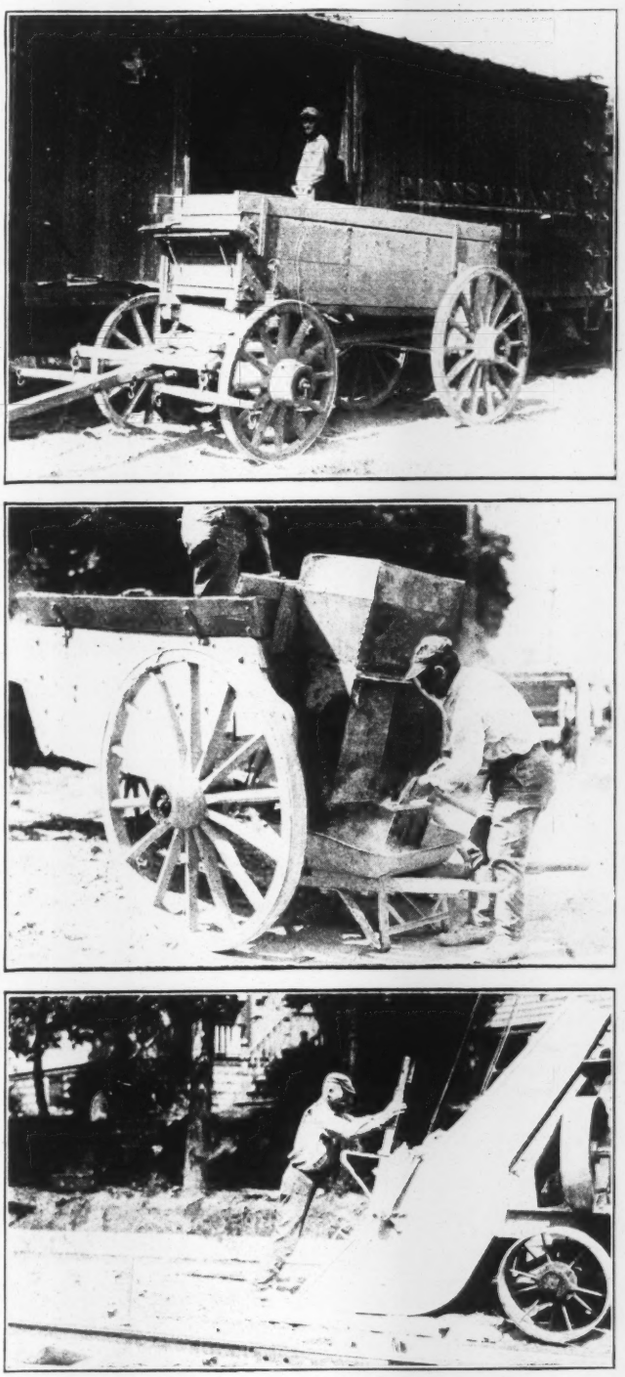
MIXER DUMPS BATCH BOX INTO ITS OWN HOPPER

SHOVEL LOADS HOPPERS OVER GAS

The contractor is Thomas E. Currie, Detroit, Mich. The track and the plant layout was planned by the engineering department of the Lakewood Engineering Co., Cleveland. The concrete work was started about July 18, and at the time of writing a little more than 1½ miles of concrete had been laid.

Wagon With Hopper Gate Handles Bulk Cement on Paving Job

BULK cement is carried in wagons that stand at the car to be loaded and at the mixer to be unloaded, is measured in a hopper attached to the wagon and is dumped into a wheelbarrow on a road contract in Milwaukee County, Wisconsin. The work is being done by Schoonmaker & Winding of Milwaukee. The road, 1½ miles long and 29 ft. wide, requires about 7500 barrels of cement. The work is one block from the railroad team track at the closest point, and a mile at the farthest. All materials are being hauled to the work by wagons or trucks.



ONE TEAM HANDLES TWO WAGONS—CEMENT SHOVELED INTO HOPPER AND DRAWN INTO WHEELBARROW IS DUMPED INTO CHARGING SKIP

The bulk cement is shoveled from box cars into ordinary wagons, the only preparation of which consists in nailing cloth over the cracks, where they occur, in the sides and bottom. Cement is measured in a combination hopper and measuring chute. This hopper is made of 16-gage sheet steel and weighs less than 100 lb. It has two slides, between which is measured 2 cu.ft. of cement. The hopper and the chute are filled by shoveling from the wagon with the bottom slide closed. When the hopper is filled the top slide is closed and the bottom one opened, filling the wheelbarrow.

More wagons than teams are required for this method, and of course the teams are unhooked when a loaded wagon reaches the job. A two-bag batch mixer is being used on the work, requiring the use of two wagons and one team. Three men, in addition to one teamster, are employed, one loading wagons at the car, one shoveling from the wagon to the hopper, and one wheeling from the hopper to the mixer. The wheelbarrow man operates the slides.

The contractors claim a saving of 27c. a barrel, including 15c. saving in the price of bulk cement. Not only is the work costing less, but labor, which is so scarce and difficult to get at the present time, is economized also.

Spare Plant Units Insurance Against Accidents

PLANT breakdowns can always be best forestalled by keeping equipment in good repair. A repair gang cannot, however, prevent accidents. A wrecked paving mixer was the first thing that caught the eye on a road job visited not long ago. The paver had been working up-hill. In some way a steel dump car load of concrete materials broke loose at the top of the hill and banged down into the mixer. Road pavers are not designed for bumping posts, and when the car had been disentangled neither it nor the mixer was fit for active service. In fact, the repair gang asserted that hospital leave for at least a week would be required to put the mixer back on the firing line. When a contractor is running 700 ft. a day on a rush concrete paving job, an enforced shutdown of six days is not pleasant to contemplate. The contractor for this job was, however, a disciple of preparedness. Two months before he had purchased a spare mixer which had been standing at job headquarters, covered, and with paint unscratched, waiting for just such a contingency as arose. Before the working day of the accident was over the gang had cleaned up the wreckage and restored the subgrade for concreting. By the next morning the spare mixer was on the grade, and the gang was unreeling its ribbon of concrete as if no accident had occurred.

The obvious moral of this tale does not end with the spare mixer. On this same job the contractor kept in stock spare cars so that he need not cut down his train lengths and reduce output if accident or breakdown put a number of cars out of service. Spare units of vital plant elements are first-class accident insurance.

C. S. H.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

College Heads Discuss War Educational Plans

Army Representative and Institution Leaders Consider Training Program for Students

Enthusiasm at the highest pitch marked the meetings of the three hundred college and university heads attending the conference of the Middle West region called to meet Aug. 30-31 at Fort Sheridan, Ill., by Col. Robert I. Rees, chairman of the committee on education and special training of the War Department. The object of the conference, which will be repeated for the Eastern schools at Plattsburg, N. Y., and Pacific Coast schools at the Presidio, San Francisco, is to acquaint the school authorities with the program of the Students' Army Training Camp. It was prolonged to two days, largely for the purpose of giving the presidents a chance to get into the spirit of the training camps. Many of their own students are in training at the place of conference.

Colonel Rees opened the meeting with a full explanation of the intensive training desired and the revised plans, as noted in these columns last week. Maj. W. R. Orton made a statement concerning the military program, which will take up 13 hours a week, and Dr. J. R. Angell, dean of the University of Chicago, outlined the courses which are to be followed, so far as the equipment and facilities of the various schools will permit. These are divided into two classes: Those of direct value to the army, such as engineering, chemistry and medicine, and those which will develop the practical judgment of the men for line officers. For the arts schools the latter only are possible, and of the following studies no doubt exists as to their value: English composition; French; Italian (perhaps); elementary physics and chemistry; American history; contemporary European history, with which should be combined a course on causes of the war ("Put teeth into this," said Dr. Angell); geology; geography; elementary economics; political science and civil government and international law. The colleges have an opportunity, in Dr. Angell's opinion, to prove to the country, now as never before, their real worth. They will attempt to do twice as much as usual in half the time.

C. R. Dooley discussed the vocational section, which will be merged with the collegiate section only so far as the military training is concerned. Grammar school graduates are eligible to these, and have an opportunity to advance from the vocational to collegiate grades. Some collegiate students will be put back into the vocational classes. It is a purely American and democratic arrangement.

Faculty status was warmly discussed, but Colonel Rees indicated that it was impossible to commission the professors, and that they should consider the instruction of these men as the greatest patriotic service possible.

Other topics discussed include treatment of technical students, relations of naval reserves, relations of military and college authorities, mess, athletics, supply and equipment, housing and the contract with the Government.

War Activities Will Dominate City Managers' Annual Convention

War activities of cities under the manager plan will dominate the program of the fifth annual convention of the City Managers' Association, to be held at Roanoke, Va., Nov. 6-8. The convention will mark the tenth anniversary of the establishment of the city manager plan, which had its birth in Virginia. The association states that of the 124 manager cities now in existence one-third are within 300 miles of Roanoke and more than two-thirds within 600 miles.

Heads of Aircraft and Munitions Appointed

Secretary of War Baker on Aug. 27 announced that he had that day selected John D. Ryan to act as second assistant secretary of war, in charge of the air service, and had designated Benedict C. Crowell, first assistant secretary of war, to have special responsibility for the munitions program. Mr. Ryan had been in charge of the Bureau of Aircraft Production, acting jointly with General Kenly, who is the head of the Bureau of Military Aëronautics. Mr. Ryan will now be in complete charge of the production and operation of all army aircraft. A new head of the Bureau of Aircraft Production will be selected by Mr. Ryan. The navy fleet will remain under the Secretary of the Navy. Mr. Ryan succeeds E. R. Stettinius as second assistant secretary of war and Mr. Stettinius remains in France, where he is now, as the special representative of the War Department, with full power to carry out special missions.

Mr. Crowell, who has been first assistant secretary of war for some time, has now the necessary power to see that the munitions required for our military operations are procured and furnished to the armies in the field.

Policy Defined on Use of Bituminous Materials

Highways Council Considers That Dust Laying Is Their Least Important Function

The enormous increase in the demand for fuel oil due to war activities made it necessary to regulate the supply of petroleum, asphalt, and tar products for highway work, says bulletin No. 2 of the United States Highways Council. Most of these materials are made from raw products which are either directly or indirectly available as fuel, and, while conserving this, the limited supply of petroleum, asphalt, and tar products should logically be used where it will be of greatest benefit.

Upon the assumption that the use of a certain amount of these products is absolutely necessary to the welfare of the country and to the successful prosecution of war measures, conservation of the present stock for the most necessary purposes releases, for the manufacture of fuel oil, crude materials which would otherwise be used in the manufacture of road materials. All grades and types of petroleum, asphalt, and tar products are, therefore, classed as potential fuel. Some of these products may be directly used as fuel, others may be made suitable for fuel by combination with light fluxes.

The relative importance of different classes of road work were explained in Bulletin No. 1 and reported in *Engineering News-Record* of Aug. 29, p. 423. Dust laying is considered the least important use of petroleum, asphalt, and tar products during the period of the war.

No hard-and-fast rules can be applied to the policy governing the release of petroleum, asphalt, and tar products for road purposes. Different and constantly changing production, storage and transportation conditions exist in various parts of the country, and every application must, therefore, be considered on its own merits.

No special permits are required for the release of fuel oil to be used in the operation of road or paving plants, if the project for which the fuel oil is desired has been approved by the United States Highways Council.

No applications for petroleum, asphalt, and tar products will be considered unless approved by the proper state highway departments, except that application for materials to be used directly in work for the Federal Government will not require the approval of any state highway department, but must have the approval of the United States Highways Council.

War Power Plant Bill in Committee Hearing

Hearings on the bill appropriating $200,000,000 for Governmental aid to power plants, noted in *Engineering News-Record* of last week, p. 420, have been held before the Committee on Interstate and Foreign Commerce of the House of Representatives. Before that committee appeared Secretary of War Baker, B. M. Baruch, chairman of the War Industries Board, and representatives of the power section of the War Industries Board. It was clearly brought out in the hearing that the measure is intended entirely as a means of meeting a war emergency. Secretary Baker, for instance, said: "This is not the place to settle the great policy of Federal ownership. What we want to do now is to get the power"; and Mr. Baruch said, "There is no desire, so far as I am concerned or so far as the men I have asked to draw the bill are concerned, either to accelerate or retard Government or municipal ownership. We want to keep that question out of it. This is a war emergency."

It is the intention of the Government officials so far as possible to utilize existing power stations by enlarging the individual stations or by consolidating several stations. Projects under way but halting on account of lack of funds will be taken over by the Government or will be assisted financially. On account of the need of early production, it is not expected that much hydroelectric power will be involved.

Government Registration Blank to Classify Engineers

A Government registration blank for classifying engineers has been issued by the division of engineering, United States Employment Service, at Chicago, as another step toward the registration of all members of the engineering profession under the jurisdiction of the employment service. Engineers are urged to call or write to the Director of Engineering, 29 So. La Salle St., Chicago, for blank classification forms to be filled in and returned.

The form first provides for a record of experience, by years, in various branches of engineering, as consulting, designing, contracting, construction, operation, valuation and scientific management, surveying and drafting. At the same time the registrant indicates his special classification as a civil, mechanical, electrical, mining or chemical engineer. Provision is made for the designation of other special subjects. The classification blank also includes provision for the listing of experience in subclassifications under the five main branches of engineering. Bridges, reinforced concrete, highways, railways, harbor work, dams and reservoirs, municipal, water-supply, etc., are included in the subclassifications. The blank also provides for indication of the age of the registrant, his draft classification and salary.

Swamp and Cut-Over Lands Investigation

Engineers Chosen for Three Districts Into Which Country Is Divided—Elwood Mead Aids

To carry out the investigation of the reclamation of swamp and cut-over lands recently authorized by Congress, outlined in *Engineering News-Record*, Aug. 22, p. 361, the Secretary of the Interior announces the division of the country into three districts. The entire work is placed under A. P. Davis, director and chief engineer of the United States Reclamation Service.

The Western district, including the whole arid region, is under the supervision of F. E. Weymouth, Denver, Colo., who is chief of construction of the Reclamation Service and is handling irrigation work in the same region. He has charge not only of irrigation work but of the drainage which is incidental to and related to the work of irrigation and which comprises practically all the drainage problems of the arid region.

The Northern district includes Missouri and the territory north of the Ohio River and east of the 98th meridian. This is in charge of F. W. Hanna, who constructed and operated the Boisé Canal system and was later supervising engineer of the Southern district of the United States Reclamation Service. Still later he was consulting engineer in that service. Mr. Hanna also has charge of the investigation of cut-over lands in the Northwest, this problem being closely related to similar problems in the region of the Great Lakes.

The Southern district, which contains the largest area of swamps, is in charge of H. T. Cory, consulting engineer, San Francisco, who has had wide experience on construction work with the Southern Pacific Ry., including the spectacular closure of the Colorado River when it was flowing into Salton Sink and threatened to submerge the Imperial Valley.

Prof. Elwood Mead, Berkeley, Cal., is engaged upon a study of the interests and requirements of the settler. Dr. Mead has been successively state engineer of Wyoming, chief of irrigation and drainage investigations in the United States Department of Agriculture, professor of irrigation institutions of the University of California, chairman of the State Rivers and Water-Supply Commission, Victoria, Australia, and is now professor of rural institutions, University of California, and chairman of the California Land Settlement Board.

Another Concrete Barge Launched

Concrete barge construction is under way at the Interocean Barge & Transport Co. at Seattle. On July 6 a deck barge 116 ft. long, 34 ft. wide and 9 ft. 6 in. deep was launched there. The boat draws 3 ft. 9 in. light and 8 ft. 9 in. with 600 tons of cargo. The concrete was poured between May 24 and 30. Launched endwise July 6, the boat was loaded July 16 with 520 tons of box shooks and started out for a 150-mile tow through rough water. It is stated that practically no leakage developed through the concrete. The company is developing a yard on the Duwamish waterway in Seattle.

Asks Postponement of Municipal Utility Extensions

Postponement of extensions to waterworks, pavements, street car systems, lighting service and any and all other municipal utilities, except those absolutely essential to the war, is urged in a letter dated Aug. 24 sent by the Capital Issues Committee to the Public Utilities Commissions of every state. The committee also urges that public service companies be freed from franchise obligations which can be dispensed with in the present emergency.

Opportunities for Commissions in the Signal Corps

Announcement has been made that the Signal Corps will establish at the cantonment at Camp Meade, Maryland, Oct. 1, a school for enlisted candidates for commissions in the corps. Sending 400 men to this school for a course of instruction lasting about three months is contemplated. Upon the conclusion of the course students who have successfully graduated will receive commissions as second lieutenants in the Signal Corps. The school is open to enlisted men who are more than 20 years and 9 months of age and who possess a fundamental knowledge of electricity. Men in the service who wish to enter will have to be taken into the service either by induction or enlistment, the latter, of course, not now being possible to men below 45 years of age. When the new draft law goes into effect other arrangements permitting men not yet in the Army to enter the camp will probably be made.

Reduction of Nonwar Work Relieving Labor Shortage

There is a noticeable relief of labor shortage in certain sections of the country, as a result of the reduction of nonwar work. Reports from Indiana, in the national labor survey of the United States Employment Service, for the week which ended Aug. 10, showed that a diminished output of passenger automobiles is releasing mechanics for employment in war work. In other sections, also, the survey has found, conservation of man-power as well as of fuel and material has been gained by the reduction of output of so-called nonessentials.

The survey shows, however, that the general skilled labor shortage is almost as serious as that of common labor. A dearth of machinists, boiler makers and molders can only be relieved by transfers from local nonwar industries.

Santa Ana River Flood Control and Water Conservation

Control of floods and conservation of water in the Santa Ana River in southern California, from the San Bernardino Mountains along the entire course of the river of about 90 miles, through San Bernardino, Riverside and Orange Counties, to its mouth in Newport Bay, is a project of such size and importance that it must be undertaken with the assistance of the Federal, state and county governments and individual and community interests, according to a report recently made by the board of engineers of the Tri-Counties Reforestation Committee of the three counties. Enough water could be saved to irrigate 40,000 acres additional, says the report.

About three years ago the river cut a new channel from a point about 10 miles from its mouth into Newport Bay. In the report of the board of engineers warning is given that the stream under flood conditions may return to its old channel and thus cause immense damage to lands and improvements between the old and the new channels. The report also points out that silt, instead of being deposited on lowlands as formerly, is now carried into the navigable waters of Newport Bay, and recommends that this be prevented. Methods that should be used, says the report, include reforestation, afforestation, storage reservoirs, retardation works, spreading of waters, channel rectification and bank protection.

The board of engineers was composed of John H. Quinton, Frank Olmsted, A. L. Sonderegger and W. K. Barnard, all of Los Angeles.

Seattle Power Project Approved by San Francisco Engineer

At the request of the Seattle municipal authorities M. M. O'Shaughnessy, city engineer of San Francisco, recently made an inspection of and report on the proposed hydro-electric development on the Skagit River in Washington. The City of Seattle plans a $5,500,000 bond issue to cover the cost of development at this site, as outlined in *Engineering News-Record* of Aug. 1, p. 248. Mr. O'Shaughnessy's report approves the plan as proposed by the city and, in general, confirms the findings on the basis of which the city is proceeding with the plans. "The securing of power rights on Skagit River is a wise measure," the report states, "and the early development of the cheapest power unit is a necessary enterprise for the city at the present time." As to power available, Mr. O'Shaughnessy reported that the Skagit River should furnish a field of development ample for the next fifty years of the city's growth.

The total cost of $5,213,000, as estimated by city officials to cover dam, tunnels, penstock, complete power house, transmission line and substation, was thought by Mr. O'Shaughnessy to be conservative. The use of cedar poles for the transmission line was suggested as effecting a saving of $4000 per mile, or $412,000 for the 103 miles. These poles should have a life of 15 years, which would defer the use of steel until that commodity becomes cheaper than at present. Detailed borings and studies of dam foundations are recommended, but from the indications observed, final results will be satisfactory, Mr. O'Shaughnessy believes. A power plant built as an initial development in the lower reaches of the river and fed by the natural flow of the stream will not during periods of lowest flow deliver its maximum efficiency until supplemented by storage on the higher levels. The plant should therefore be designed and located, the report points out, with the purpose of creating storage reservoirs at higher levels.

Contractors to Organize September 30

Executive Committee to Perfect National Association—Meeting Called at New York

Contractors throughout the country are expected to perfect the machinery of a national organization at a meeting of the executive committee formed for that purpose as a result of the convention of building industries held July 15 and 16 at Atlantic City. The members of the committee, announced in *Engineering News-Record* of Aug. 1, p. 245, have been requested to meet at 51 Chambers St., New York City, on Monday, Sept. 30.

It is stated that much interest has been shown in the proposed form of constitution submitted to the committee members for discussion, and in consequence, those engaged in the movement expect the committee to develop comprehensive plans which will lay the foundation for an organization that can be of the greatest service to contractors and to the country, both now and after the war.

Baltimore Paving Commission Disbands

The paving commission of the city of Baltimore, organized under act of the state legislature in May, 1911, and authorized to spent an amount estimated at $10,000,000 to repave the streets, disbanded on Sept. 1, for the period of the war. To the present time $7,000,000 has been spent, but because of the high cost of material and the difficulty of getting contractors it was decided to discontinue work. During its régime the commission has removed 2,450,000 sq.yd., or 138 miles, of old cobblestone pavement; approximately 2,500,000 sq.yd. still remain in the city. In place of the cobblestone pavements, the commission has laid 1,640,000 sq.yd. of sheet asphalt, 490,000 sq.yd. of granite block, 562,000 sq.yd. of vitrified brick, 92,000 sq.yd. of bituminous concrete and about 72,000 sq.yd. of paving of wood block, cement concrete and other modern materials. The average cost, including the overhead charges, was $2.40 per square yard. Based on a street width of 30 ft. from curb to curb, this represents 161 miles of improved paving at an average cost of $43,300 per mile. The overhead charge amounted to only 5% of the total expenditure. The commission consisted of Maj. R. Keith Compton, chairman and chief engineer, Douglas H. Thomas, Samuel C. Rowland, Leonidas G. Turner, William S. Thomas and the late Gen. A. E. Booth. Mayor Preston is a member ex officio. Upon the resignation of Major Compton, Frank K. Duncan, one of the commission's engineers, was made acting chief engineer.

To Conserve Oakland Water-Supply for War Industries

An order issued Aug. 21 by California officials of the United States Shipping Board forbids the sprinkling of lawns and gardens and calls for a general conservation of water in Oakland, Alameda and Berkeley. These communities are served by the East Bay Water Co., which has recently had to meet the demand for 6,000,000 gal. of water more daily for use of shipyards and other war industries. The conservation order is expected to reduce consumption from 22,000,000 to 17,000,000 gal. daily. If this is found to be an inadequate reduction, a water ration of 15 gal. per person per day may be put into effect. Water storage in Lake Chabot, the company's main source of supply, is far below normal this season. The lake is now 40 ft. below the usual water level and the company has had to resort to well supplies. It was expected that new wells would be in service by Sept. 1, which would furnish 4,000,000 gal. more. It was planned then to cut off the Lake Chabot supply for a week in order to remedy the present muddy condition of the water, caused by pumping from the low levels. When the lake is cleared, and with the new well supply and the savings ordered, the situation will be relieved somewhat. However, no material improvement in the general situation is expected by the company until the winter rains come.

Akron Votes $2,000,000 Water Bonds

Considerably more than the necessary two-thirds vote was cast at Akron, Ohio, Aug. 13 for $2,000,000 water bonds. The Capital Issues Committee has approved marketing $1,315,000 of these bonds in 1919. The city will advertise at once for laying 8 or 10 miles of distribution pipe already in hand. Later this year contracts will be let for other parts of the 1918 program, including a 48-in. force main from the reservoir and pumping plant to the city. H. S. Morse is director of public service.

Ask Study of Water Waste in Railroad Yards

Because the railways entering Jersey City use nearly a third of the water-supply there, and because of the serious water shortage of last winter, the Chamber of Commerce of Jersey City has requested the regional director of the Railroad Administration to make a study of water consumption and possible waste through leaks or otherwise in the Jersey City yards. The chamber, through Fred Van Zandt Lane, manager, states that the per capita water consumption of 160 gal. a day in Jersey City is believed to be excessive, notwithstanding the large use of water by railways.

Concrete Boats Being Built for Four Branches of Government

Concrete ships, barges and lighters to the number of 102 are now under contract by four separate branches of the United States Government. The names of the companies holding the contracts, the types of boats and the situations of the yards are given in the accompanying table.

TABLE SHOWING GOVERNMENT CONCRETE BOATS UNDER CONTRACT

Government Agency	Type of Boat	No.	Name of Contractor	Location of Yard.
Emergency Fleet Corporation..	3500-ton Freighter.....	1	Fougner Concrete Shipbuilding Co.....	Astoria, L. I.
	3000-ton Freighter.....	1	Liberty Shipbuilding Co.....	Brunswick, Ga.
	3500-ton Freighter.....	2	Liberty Shipbuilding Co.....	Wilmington, N. C.
	7500-ton Tanker.....	6	LibertyShipbuilding Co.....	Wilmington, N. C.
	7500 - ton Tankers and Freighters.....	8	San Francisco Shipbuilding Co.	Oakland, Calif.
	7500 - ton Tankers and Freighters.....	8	F. T. Ley & Co.....	Mobile, Ala.
	7500 - ton Tankers and Freighters.....	8	A. Bentley Sons.....	Jacksonville, Fla.
	7500 - ton Tankers and Freighters.....	8	Schofield Eng. Co.....	San Diego, Calif.
Navy Department	500-ton Harbor Lighters....	4	Ambursen Consn. Co.....	Little Ferry, N. J.
	500-ton Habor Lighters.....	4	L. L. Brown Co.....	Peekskill, N. Y.
Railroad Administration (Construction Supervised by E. F. C.).....	500-ton N. Y. Barge Canal Barges.....	8	Holler-Davis & Flood Co.....	Fort Edward, N. Y.
	500-ton N. Y. Barge Canal Barges.....	4	Caldwell-Marshall Co.....	Tonawanda, N. Y.
	500-ton N. Y. Barge Canal Barges.....	5	Thomas & Currie.....	Detroit, Mich.
	500-ton N. Y. Barge Canal Barges.....	4	Cummings Concrete Constructional Eng. Co.....	Ithaca, N. Y.
War Transport Branch, War Dept.	130-ft. River Boats.....	14	West Coast Sbldg. Co.....	Wilmington, N. C. & Everett, Wash.
	100-ft. Water Tankers.....	5	Gt. Northern Sbldg. Co.....	Portland, Ore.
	225-ft. Car Floats.....	6	Liberty Sbldg. & Transp. Co...	Cleveland, O.
		6	L. B. Harrison Co.....	Athens, N. Y

Mouth-of-Mine Power Plant Near Pittsburgh

In order to help out the power situation in the Pittsburgh district, the West Penn Power Co. has agreed to build a 40,000-kw. station at the mouth of a coal mine in the Alleghany valley and connect it up by an appropriate transmission system with the distribution system of the city of Pittsburgh. The estimated cost of the plant and transmission lines is $5,000,000. The Ordnance Department, United States Army, will advance $2,000,000 of this amount and the company will provide the remaining $3,000,000. Three years after the end of the war the reproduction cost of the plant is to be determined by three disinterested appraisers, one chosen by the Secretary of War, one by the company and the third by agreement of the first two, and their finding is to be subject to review and revision by the Secretary of War. The company undertakes to repay to the Government such part of the advance made by the Government as represents the excess of the appraised value over the $3,000,000 originally put up by the company.

Motor Transport Corps Formed by War Department

Creation of a motor transport corps, which will consist eventually of approximately 5000 officers and 200,000 men, to have charge of all motor vehicle transport in the Army, has been announced by the War Department. It is hoped that such an organization will expedite the movement of troops and supplies for the American Expeditionary Forces in France.

Heretofore all motor transport was under the control of the Quartermaster Corps, but it has grown to such proportions that it was deemed advisable to organize a separate corps and take further steps for its rapid expansion. All forms of motor transportation, with the exception of tanks and caterpillar tractors which are used to haul artillery, are transferred to the new corps. The tanks and tractors will remain under the supervision of the artillery and ordnance branches.

In combining transportation facilities, one of the advantages sought is the better standardization of equipment, resulting in greater efficiency and economy of operation and permitting a more general interchange of parts. The problem of supplying parts and making repairs is extensive; there are many repair stations in France which are operated by from 500 to 1500 mechanics each.

The new corps is in charge of Col. Charles B. Drake.

Empire Engineering Company Elects Officers

The Empire Engineering Co., Inc. of New York elected the following officers and directors at a recent meeting: President and chairman, J. H. McClement; vice-president and general manager, J. Rulon Miller, Jr.; vice-president, Beverly R. Value; secretary, treasurer and comptroller, C. A. Nicklas; directors, J. H. McClement, Alfred Skitt, Franklin Nevius, Beverly R. Value, J. Rulon Miller, Jr., and C. A. Nicklas. The Empire Engineering Co. is the name which was adopted when the name of H. S. Kerbaugh, Inc., was changed in 1917.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

NEW ENGLAND WATER-WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 11-12, Boston.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; A. Dennis Williams, Morgantown, W. Va., acting secretary; Dec. 2-6, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York City; Dec. 3-6, New York.

Personal Notes

J. G. Sullivan, until recently chief engineer of the Canadian Pacific Railway Co., announces that he has opened a consulting engineer's office in Winnipeg, Man. Mr. Sullivan is a member of the American Society of Civil Engineers, Engineering Institute of Canada, and the American Railway Engineering Association.

Lincoln Bush, consulting engineer, New York City, has been commissioned as colonel in the construction division, Quartermaster Corps.

H. R. Safford, recently chief engineer of the Grand Trunk Ry., has been appointed engineering assistant for the Central Western Region, United States Railroad Administration, with office in Chicago. Mr. Safford, who was graduated from Purdue University in 1895, entered the service of the Illinois Central R.R., that year, and was successively rodman, assistant engineer,

roadmaster, principal assistant engineer, assistant chief engineer and chief engineer maintenance of way. Subsequently he left the Illinois Central to become chief engineer of the George B. Swift Co., general contractors, of Chicago, and in 1911 he was called to the Grand Trunk as chief engineer.

GEORGE F. WIEGHARDT has been appointed highway engineer of Baltimore, Md. As such he will be a member of the Board of Estimate. Mr. Wieghardt was born in Baltimore in 1887 and received his early education in the public schools of that city, and was graduated with honors from the Polytechnic and Maryland Institute. He was graduated from Cornell University with the degree of civil engineer in 1909, receiving the Fuertes medal for the best standing in his class for three years. He has had a varied experience, mostly in Baltimore, on sewage and water-works construction, and in 1914 was appointed assistant to the chief engineer of the Pennsylvania Water Supply Commission. In 1916 he was appointed principal assistant engineer of the water department of Baltimore, which position he held until his present appointment. He succeeds Maj. R. M. Cooksey, who resigned to enter the army.

CHARLES H. HIGGINS has been commissioned a major in the Ordnance Department. Mr. Higgins was born in Southington, Conn., in 1879, and was graduated from Princeton University in 1903 with the degree of civil engineer. From 1903 to 1911 he was connected with the S. M. Stillman Co., general contractors, Jersey City, N. J., as draftsman, superintendent of construction and engineer, and had supervision of a number of important engineering structures for the Pennsylvania R.R., the Jersey City Stockyards Co., the Magnus Metal Co., the Lister branch of the American Agricultural Chemical Co., Newark, N. J., the Brooklyn Union and New York Mutual Gas Companies, the Pintsch Compressing Co., Jersey City, Central R.R. of New Jersey, and also of a number of municipal structures. Since 1911 Mr. Higgins has been conducting a general consulting engineering business with offices in New York City, recently forming the new firm known as the Delano & Aldrich and Charles H. Higgins Co., which firm will carry through the various engineering projects under way for both companies.

WILLIAM I. VAN ARNUM has been appointed superintendent of the water purification plant at Youngstown, Ohio. For seven years Mr. Van Arnum was superintendent in charge of the water purification plant at Cohoes, N. Y., and later was connected with the Bridgeport Hydraulic Co., Bridgeport, Conn., from which activities he goes to the superintendency of the plant at Youngstown, Ohio. Mr. Van Arnum will assume his new duties on Sept. 9.

JOHN D. GARVER has been commissioned lieutenant in the navy and made instructor in the United States Naval Steam Engineering School, Hoboken, N. J.

WALTER CHARNLEY, who was engaged on port and harbor and other works in Brazil, and before that was in Mexico on railroad and harbor construction and survey, has been commissioned as first lieutenant and is in training at Camp Humphreys, Virginia.

F. T. HATCH, formerly chief engineer maintenance of way of the St. Louis system of the Pennsylvania Lines, has been made consulting engineer to the corporation and will have charge of valuation, with office in St. Louis.

H. P. BOARDMAN, professor and civil engineer and acting dean of engineering at the University of Nevada, Reno, has returned to his university duties after a leave of absence to engage in Government work. Since the first of March Professor Boardman has been engaged as engineer on the construction of the United States Explosives Plant "C" at Nitro, W. Va.

R. B. SHEPARD, JR., office engineer in the valuation department of the Atlantic Coast Line R.R., has been appointed valuation engineer. He succeeds D. W. Gross, who has resigned to enter the service of the corporation.

C. N. BAINBRIDGE has been appointed assistant engineer in charge of bridge inspection and bridge erection on the lines of the Chicago, Milwaukee & St. Paul Ry., east of Mobridge, S. D., succeeding E. S. Meloy, deceased.

C. A. FORTER has received a commission as first lieutenant in the sanitary corps. Mr. Forter has been representing the John Baker, Jr. Company of Kansas City and was for many years office engineer in the city engineer's office at Topeka, Kan.

MAURICE COBURN, principal assistant engineer of the Pennsylvania Lines West, with office in St. Louis, has been transferred to Indianapolis as supervising engineer.

RAYMOND BURNHAM, designer of coal tipples for Fairbanks, Morse & Co., has been commissioned captain in the Engineer Officers' Reserve Corps. After graduation from Sheffield Scientific School, Yale University, in 1903, he was with the Mexican International Ry. for one year on topography, and for two years in Panama on an exploration survey. For the next six years he was a mining engineer on various projects in California, Idaho and Mexico, returning again to civil engineering work in 1912 with C. W. Humphrey, consulting engineer, Chicago.

W. A. CLARK, chief engineer of the Duluth & Iron Range R.R., has been appointed chief engineer also of the Duluth, Missabe & Northern Railway.

A. R. COOK, principal assistant engineer of the Northern Pacific Ry., with office in Tacoma, Wash., has been appointed engineer maintenance of way for the line west of Paradise. He succeeds L. M. Perkins, transferred.

OBITUARY

LIEUT. ROBERT E. A. MACBETH was killed in an aviation accident at a training camp near Birmingham, Eng., on Aug. 19. He was a graduate of the School of Practical Science, Toronto, and prior to his enlistment was assistant city engineer of Toronto. He completed a course in aviation in December, 1915, and was sent to England, where he saw considerable service and was latterly engaged in passing upon airplanes before their acceptance by the Imperial Government.

MAJ. FREDERICK WILLIAM WATKINS, with the Department of Water Supply, Gas and Electricity, New York City, until 1914, when he was retired, died at his home in White Plains, N. Y. He was 75 years old and a veteran of the Civil War, which he entered as a private in the Union army. He served in the First New York Volunteer Engineers, also in the artillery and infantry, and was brevetted at the close of the war major of volunteers after winning successive promotions. Major Watkins was graduated as a civil engineer from New York University in 1868 and was employed on railroad construction work for fifteen years before entering the service of the aqueduct commission as assistant engineer in 1884.

MORLEY DONALDSON, formerly vice-president and general manager of the Grand Trunk Pacific Ry. at Winnipeg, died at Ottawa on Aug. 27 at the age of 65. He was born in Edinburgh, Scotland, coming to America as a young man. He entered the service of the Canada Atlantic Ry. in 1881 as chief draughtsman and rose to the position of general superintendent. When that road was merged with the Grand Trunk in 1905 Mr. Donaldson became general superintendent of the Ottawa division of the system, and in 1912 was appointed vice-president and general manager of the Grand Trunk Pacific at Winnipeg, from which position he resigned about a year ago. He was a member of the Canadian Society of Civil Engineers.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

War Industries Threatened by Steel Shortage

Nonwar Plants May Be Entirely Shut Off—Labor and Fuel Chief Factors in Serious Situation

Reports that the output of certain important war industries was seriously threatened by the steel shortage were responsible for a meeting in Washington between representatives of the steel industries and the War Industries Board, followed by a meeting in New York of the heads of steel producing companies throughout the United States. Owing to the greatly increased tonnage required by our European allies, and to the labor and fuel shortage, the supply of steel in the United States will be entirely restricted to the needs of the War and Navy departments, the railroads and the shipyards.

Late last May indications were that the steel producers would reach 100% production, having averaged up to that time 93%. Basing calculations on the 1917 output, and the plant extensions placed in service in 1918, it was predicted that steel production would pass the 50,000,000-ton mark this year. Now, however, with a reduced instead of an increased output, the requirements for the last half of the year call for upward of 23,000,000 tons, and may reach 25,000,000 tons. At the present rate of output the capacity is but 17,000,000 tons of rolled steel.

Estimates in the early part of the year were also based on the probability, as indicated at that time, that both the fuel production and the shipping facilities would meet the situation. Although, as pointed out by the Fuel and Railroad Administrations, great strides have been made and progress effected, the labor situation, the difficulty in which was not apparent in the early months of the year, has become so acute that it entirely upsets the predictions made. Instead of a 100% capacity output, as indicated, today the report is of but 92% output. It was 93% at the time the estimate was made.

To formulate measures to meet this situation the conferences held in Washington and New York were called. At these meetings greater conversion of mills to steel production was decided upon, as well as an increase in the coal supply and the further curtailment of supplies for lesser essential industries.

Steel for the manufacture of passenger automobiles has been almost entirely shut off, and the recommendations of the War Industries Board to the various automobile manufacturers to effect a 100% conversion war production by Jan. 1, 1919, indicates to what extent the restriction of steel will be carried by that time. Those factories which have stocks of steel on hand were notified that in case of necessity they would have to share them with factories producing war essentials. On the other hand, it was pointed out that the Emergency Fleet Corporation had a reserve supply on hand of 1,200,000 tons of steel, which with the 66,000-ton reserve to be shipped in October and the 50,000-ton weekly deliveries now being made, will furnish stock on hand for 4,000,000 tons of shipping. This is more tonnage, some believe, than both the wood and steel shipyards will be able to produce this year. From this it is argued by some industries which feel the shortage that the Emergency Fleet Corporation is stocking up at the

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Storage of Coal by Industries To Be Strictly Limited

A limit to the amount of coal that industrial plants will be allowed to accumulate and carry on hand, and a fixed uniform amount for each state, were established at a meeting of all the state fuel administrators east of the Mississippi Aug. 20. This action was brought about by the increasing demand for coal for special war purposes in the East, particularly for the navy and transport service.

The announcement states that "coal in excess of that required for current operations shall be delivered to plants not on the preference list of the War Industries Board only when it is not in demand for use before Apr. 1, 1919, by consumers on said list; namely, railroads, the Federal Government, states, counties, public utilities, retail dealers or manufacturing plants on the preference list."

The notice further states that these limits are mandatory, and each fuel administrator is expected to see that different classes of consumers are not allowed to exceed the established limits. In particular cases, however, which may require special action by the granting of greater stocks of coal, the state and fuel administrators are permitted to grant special licenses under certain restrictions and limitations. Those companies which have reserve stocks of coal on hand at the effective date of the notice are permitted to retain them only on condition that they shall thereafter use screenings or mine run only, and shall obtain such screenings or mine run for current use only from certain specified fields.

Listing Industries for the Fourth Liberty Loan

Trade Chairman Named and 120,000 Firms Lined Up and Rated, for Use in New York City Drive

Canvassing for the Fourth Liberty Loan in New York City will be facilitated by a master list containing 120,000 names and ratings of firms listed according to industries. Trade chairmen have been named by Benjamin Strong, governor of the Federal Reserve Bank, to conduct the campaign, 40 of those named having already accepted the appointment.

There are 90 committees, representing all the industries of the metropolis, and the chairman states that the division will be in a position to begin active work a month sooner than in any of the previous drives. While the trades have set no quota for their shares in obtaining subscriptions for the new loan, which is to be floated Sept. 28, it is anticipated that they will raise about half the total of the city. In the previous drive the trades totaled $550,000,000.

Each committee chairman will have from 10 to 20 associates, and will captain a canvassing force of from 100 to 500 workers. The task of selecting this army has been going on for several weeks. The necessity for a master list was realized by trade leaders when it was announced from Washington that the Fourth Liberty Loan would call for a greater sum of money than had ever been raised by the issue of bonds. The trades will be listed according to their estimated wealth under three classifications: 1. Firms capable of rasing $10,000,000 or more; 2, firms raising from $2,000,000 to $10,000,000 and firms raising less than $2,000,000.

The trades are being formed into committees and war industries are organized under one committee. The majority of the chairmen of all the larger canvassing organizations will remain the same as for the previous loans, and the committee reports that the work has already gotten under way with a rush.

Among the committees organized are those covering the building and allied trades; electrical, paper and rubber industries; coal trade; mining industry, and import and export shipping. The master list of trades will be supplied to each subcommittee and it is stated that not a single business concern will be overlooked when subscriptions are solicited.

The Advisory Trades Committee has decided to adopt a National Community Honor Flag for firms 60% of the employees of which have subscribed.

Steel Shortage

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expense of other industries almost as essential.

Recent actions by the authorities at Washington regarding the coal supply also indicate measures under way to assist the steel manufacturers in this respect. Hoarding, or even the apparent overstocking of coal by any industry, is to be stopped, and those industries which have a larger supply on hand than is necessary will be forced to share with industries not so favorably situated. Although these steel producers have assured the Government authorities that they will do everything in their power to increase their output, they point out that it is no use to expand unless they have adequate raw materials with which to operate their larger plants.

The representatives of the steel industries and Government officials therefore point out that more serious and far-reaching economies must be practiced. Sheet steel, tin plate and wire mills will probably be cut down 50% and pig and gray iron are available only for munitions or particular war requirements.

The automobile manufacturers are the first to receive notice of curtailment from Washington. This notice will be followed by others to all the other industries using iron and steel. They will receive direct warnings of and concrete rules for the effective saving of steel to the plants supplying direct war needs. Refrigerator manufacturers as well as motorcycle and bicycle plants have received first warnings, and stove manufacturers have been notified that there will be large inroads on their allotments. Electric manufacturers and dealers have also been notified of reductions.

Jobbers will be permitted to hold stocks for Government use and for civilian orders against essential needs, but strict supervision of sales by means of pledges, etc., will be maintained.

Record Cement Production in 1917—Output Now Restricted

A record production of cement for 1917 is shown in the statistics recently produced by the cement industry in the United States. The output for the United States, however, has been restricted to 75% of the average annual production, by order of the United States Fuel Administration limiting the allotment of fuel to the various industries.

Certain exceptions are made in the order to cover urgent Government needs for cement or for the purpose of such building operations as have urgent public necessity, or where the industry is able to obtain wood or peat for fuel without depriving the railroads of the use of wood or putting a burden on them for the hauling of fuel.

Although the production of cement broke the record in 1917, the actual shipments show a small decrease from 1916, but the increase in value of the cement, from the higher prices, resulted in an advance in value of 17.8% over 1916.

Centrifugal Stucco Gun Used on Large Construction Work

A centrifugal stucco gun, invented as a result of the many difficulties encountered on the incasing in concrete of the Eastern Hills tanks, Cincinnati, described in *Engineering News-Record* of Aug. 16, 1917, p. 305, is shown herewith. It consists of a small machine driven by a ⅛-hp. motor which has four blades to throw the mortar by centrifugal force. The machine including the motor weighs 32 lb. and is carried by a strap slung around the operator's shoulders, leaving both hands free to operate the machine. It is operated by one man with a helper to feed the mortar into the receiving hopper. The gun was also used in waterproofing the interior surface of a pit 50 ft. long, 15 ft. wide and 32 ft. deep, built for the Pollak Steel Co., of Cincinnati.

The machine, it is stated, will apply from 400 to 450 ft. of stucco per hour on brick or concrete surfaces, and it is asserted that the work is superior in both quality and appearance to hand work. It is asserted also that for exterior work where metal lath or expanded metal is used no plastering is required, as this device applies the entire coat monolithically. It applies pebble dash, it is stated, of any finish desired. It also applies cement mortar to certain self-centering forms.

APPLYING STUCCO WITH NEW GUN

The machine is patented by Jesse Hodges of the Ferro-Concrete Construction Co., Cincinnati.

Business Notes

G. Ed. Ross, secretary and auditor of the Oregon State Highway Commission at Salem, Ore., has resigned his position to enter the service of the War Department at Washington as supervising accountant on the Kinney Construction Division.

The corporate interest of the Union Pacific System, together with 35 subsidiary and associate corporations, will maintain headquarters in the Gas Co. Building in Portland, Ore., during the remaining period of Federal control, according to J. D. Farrell, who is president of the auxiliary corporation and of the railway units of the parent system.

Trade Publications

"Pile Pulling" is the subject of a 7-p. pamphlet issued by the McKiernan-Terry Drill Co., which announces that the pamphlet is published for the benefit of the users of their pile hammers. It contains brief information as to the best means of rigging them to pull piling.

The Mead-Morrison Mfg. Co., of Boston, has issued a pamphlet, No. 121 B, covering the Mead - Morrison truck winches. It is illustrated with numerous halftones showing the truck with the winch attached and parts of the winch, as well as line cuts showing the application of the machinery.

From the Sprague Electric Works of the General Electric Co. has been received bulletin No. 48,-938, superseding bulletin No. 902, covering the electric grab - bucket hoist. It is a 23-p. bulletin, illustrated with halftones and tables of engineering data.

The Advance Felt Specialty & Cutting Co. has issued an 18-page pamphlet illustrating the Widney Resiliometer, an appliance that measures the thickness, hardness and resiliency of any resilient material.